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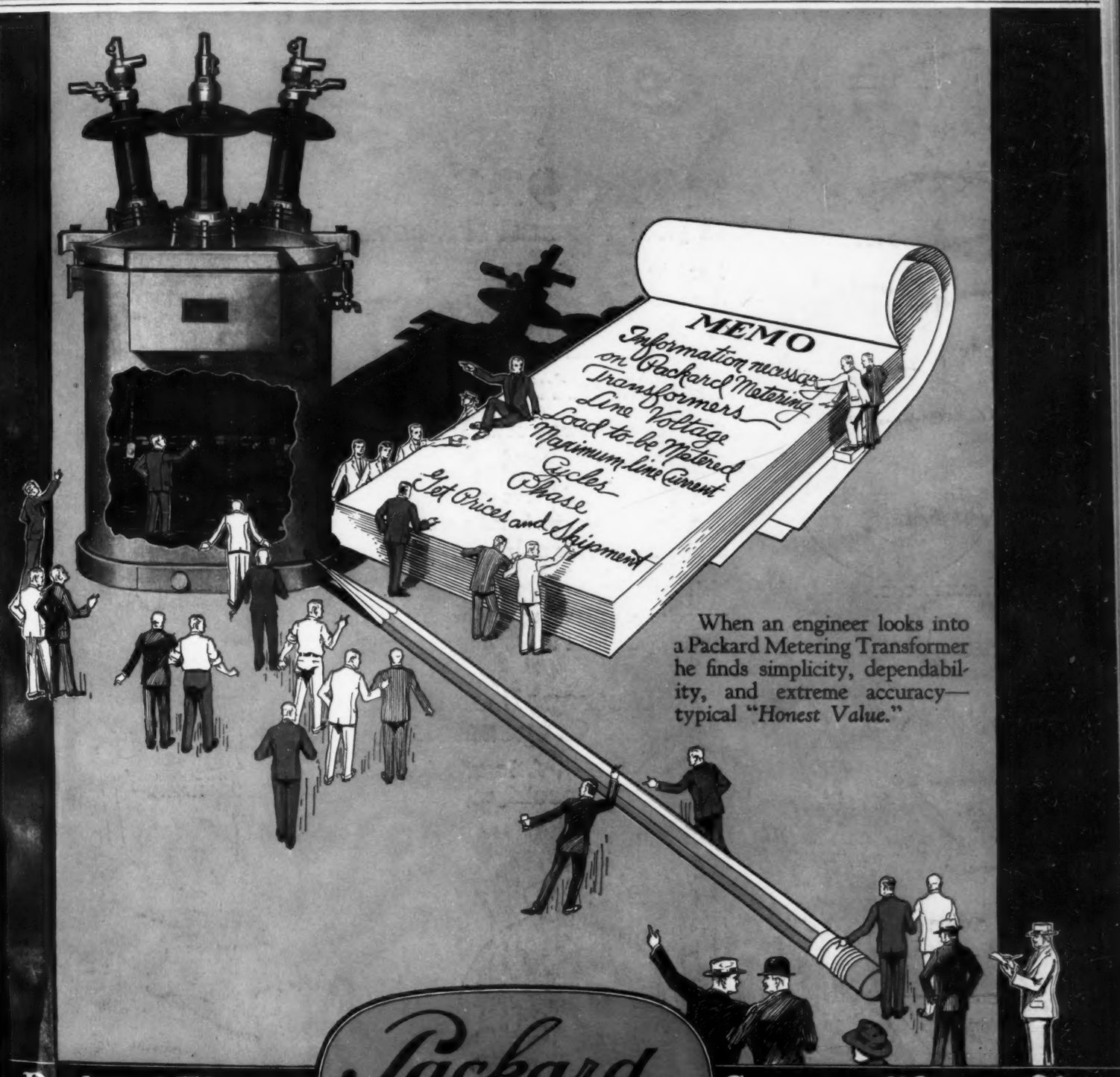

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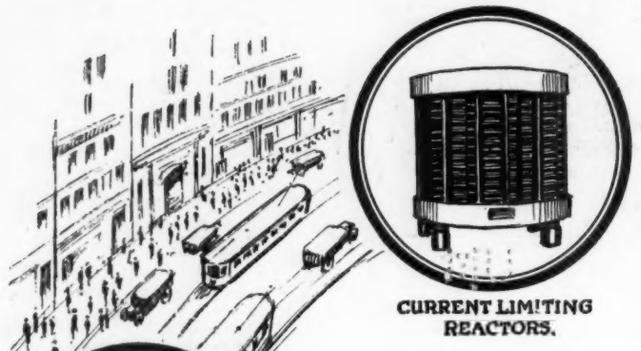

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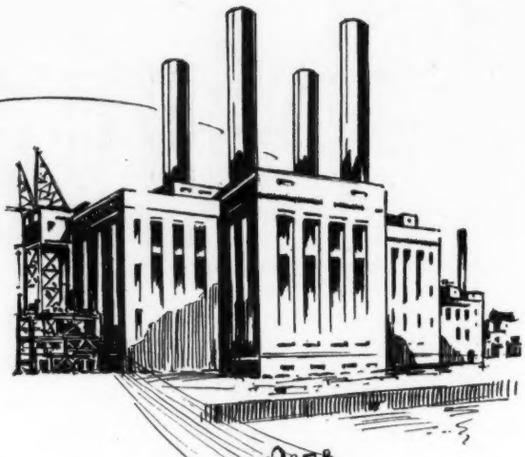

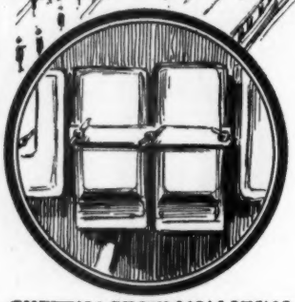

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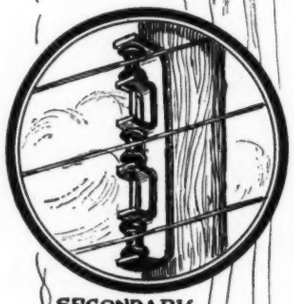

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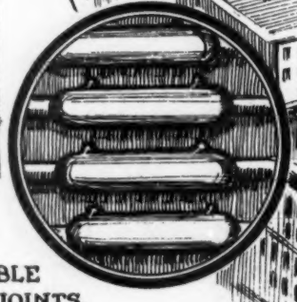

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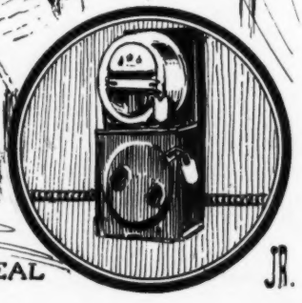

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On the 15th of every month you can have this wide-awake magazine without charge if you ask us today.

Experience Who Has It?

One of the first things you ought to know about a manufacturer with whom you are considering doing business, is his experience. Just as the first thing you want to know about a man you are contemplating as manager is to know what sort of background he may have had—how much actual experience in your line of work.

You are after results when you select a manager for your property and equally so you are after results when you select a manufacturer of equipment for use on your transmission system.

After you have questioned different manufacturers, as to what they can offer you in experience, equipment and service, ask this question of each one.

"Next to your own company what company in this country do you consider best fitted to build the equipment I need?" You probably will find that most of them will agree on one company—DELTA-STAR.

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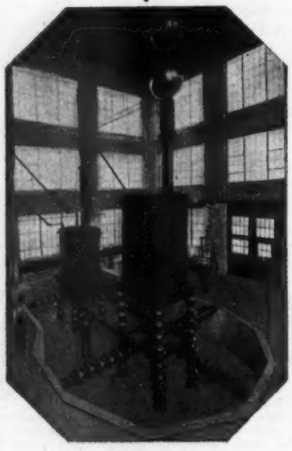
In the high tension field, DELTA-STAR is an old experienced institution, but young in spirit and the determination to keep several jumps ahead of the field.

We would like to have you visit the factory, meet our engineers, witness tests in our 750,000 volt laboratory and see for yourself our modern methods of manufacture.



This 750,000 Volt Laboratory Insures the Quality of UNIT TYPE Equipment

H. W. Young, *President,* Delta-Star Electric Co.
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Electrical World

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W. H. ONKEN, JR.
Editor

VOLUME 90 — *New York, Saturday, October 1, 1927* — NUMBER 14

Electric Power in Industry

A MISTAKEN impression exists that the cost of electric power influences the prosperity of the manufacturing industry. Much is said about cheap electric power. People are apt to forget that the cost of power is a small item in manufacturing costs. In 1925 all manufacturing industry paid $378,000,000 for purchased electrical energy. In the same year it paid labor $10,727,869,000. It added $26,757,254,000 to the value of raw products by the manufacturing process.

It is the electrical idea in mass production that has made industry prosperous. It is through the use of electrical equipment in production that the manufacturing industry has changed its economic status. The value added by manufacture per wage earner in 1914 was $1,328; in 1925 it was $3,340. The total value of manufactured product per wage earner in 1914 was $3,400; in 1925 it was $7,500. In 1914 each wage earner used 3.2 hp., but in 1925 he used 4.2 hp. These units afford evidence that manufacturing prosperity is little affected by the cost of power. The cost of power could be doubled and, compared even with the annual wage bill, the cost of manufacturing would not be increased 1 per cent.

Electrical men should talk more about the electrical idea in production and less about cheap electric power. The graphic charts in this issue show very vividly that they have much to do before they can say that industry is electrified. There is a market for 10,000,000 hp. in motors, and there is a market for utility energy sales of 20,000,000 hp. Central-station companies have not sold to half their market as yet. This market will be gained by the effect of electrical methods and equipments on production and not by the price of energy per kilowatt-hour.

* * * *

Planned Construction an Economic Need

THE past twenty years has been a building age in this country. Public utilities and industrial plants have been stressed to the utmost to build facilities needed to supply market demands. As a result planned construction and economical design were subordinated to expediency and the need of building quickly. Waste in invested dollars and mistakes in completed structures resulted, but this economic loss was more than offset by gains obtained by the productive use of new facilities.

But industry today has installed capacity more than sufficient to supply consumption requirements, and even public utilities have caught up with the immediate demands for service. Time is now available for designing and constructing new plants on a more economical basis. Moreover, investments per unit of construction and labor costs per unit of production are of a magnitude which warrants minutiæ of planning hitherto considered uneconomical. Furthermore, industrial plants and utility systems are of large magnitude and extreme complexity, and the processes involved in their operations are capable of being systematized to economic advantage. A new unit, a rebuilt unit or an addition should conform to and merge with the existing structures with least friction and cost.

But organization changes are needed to carry out this program. Hitherto the design, construction and operating functions have been centralized in one engineering department. As a consequence, operating necessities took precedence and spare-time design was practiced. Large industrial organizations need a planning engineering staff as well as an operating engineering staff if efficiency is to be obtained. As a rule, major construction work should be done by national construction organizations that have the equipment, the experience and the man power to do effective and economical work. In accord with modern trends each industry should man its own planning and operating departments with specialists, but economic gains are to be found usually if specialists in construction are retained to do work which lies in a realm of activity beyond the experience of those planning and operating a property.

* * * *

Reliable Service from Transmission Lines

CONTINUOUS and reliable electric service is essential to most manufacturing plants. It speaks well for the service rendered by light and power companies that this requirement has been met in large measure. But to render this service from overhead transmission systems is difficult and expensive and the state of the art can well be improved. The general principle followed is to supply each industrial load by feeders from at least two generating sources and to use relays which will isolate any faulty feeder when trouble occurs. This practice has been satisfactory for feeders of comparatively short length, with a minimum of exposure and with relatively small loads. But it has weaknesses and is very expensive when used on extensive transmission systems.

The advent of extensive transmission systems in large industrial areas which have very high service standards is accompanied by need for serious consideration of the problem of giving continuous service economically. Overhead lines are exposed to lightning and to accidental contacts. By far the larger number of troubles arise from line-to-ground faults. When these lines are connected to large aggregations of generating capacity and when they are built for heavy loads, faults introduce hazards to the system and to the service. System

stability will be jeopardized unless precautions are taken, and service failures may result on a large scale.

Experience of older transmission companies should be used freely in designing the contemplated systems. These older installations have undergone their growing pains and have developed through the fire of experience. Today they operate on the principle of isolating a faulty section of line just as quickly as possible, on the principle of loose-linking the system to give relatively small aggregations of generating capacity in each major system division, and on the use of oil circuit breakers as quick-acting relays to cut out faulty sections of lines. Experience has indicated that a solidly connected transmission network with breakers set to hold on at all hazards will not give equally good service results. The system stability is shaken and a multitude of services are affected by each system fault.

Some day, no doubt, the art, load density and system designs will develop to a degree where a solid generation, transmission and distribution structure may be operated, but that day has not yet dawned.

* * * *

N.E.L.A. National Commercial Leader Will Now Be Appointed

THE N.E.L.A. executive committee last week authorized the appointment of the national sales executive that the Commercial Section has been talking about so long. This is good news. Central-station men are naturally local in their thinking, and their policies for the most part are framed to suit conditions in a locality. But naturally the methods and policies of some companies are more progressive and productive than those of others, just as in some communities the market is being more skillfully developed. The time has come when standards of commercial practice must be more helpfully defined and must have national interpretation and leadership. They must be sold to the individual companies. And committees cannot do this. It needs a man—a national leader who can carry the banner of commercial progress.

"Just what will he do, this man?" people keep asking. Well, for one thing, C. E. Greenwood, chairman of the merchandising committee, proposes to hold an early conference of the officials of the national associations of all classes of merchants who sell electrical appliances, to draw up a standard of merchandising practice that everybody can agree on so that the power companies can be at peace with the dealers. But, once established, who is going to get the different power companies to adopt this standard and abide by it? The committee cannot do more than recommend. But the idea must be sold to them. Some man will have to undertake the job. There will be many such opportunities for extremely valuable service.

Again, for example, there are no comparable statistics on commercial proficiency in the power industry today. What is a good average yearly consumption per residence customer? And what should be the average yearly sale of appliances to a home? And what should it cost to do the selling? Nobody knows. In every field in which the market should be extended there is need for accurate information so that salesmen may be evaluated and executives may judge the efficiency of their business operation. For it is about time that this industry kept accurate costs on selling customers as well as serving them and began to know its market as it knows its engineering. There is no reason why one should be a science and the other guesswork.

The industry needs to have this job done and done well and now. The job needs a man—and a man who can challenge the respect and confidence of the executives. And this will not be easy, because the average utility executive has never been really interested in the processes of marketing. But it is his next big problem, and he has got to learn how to build his business, not by accumulating customers, as in the past, but by more intensive selling to existing customers—if power systems are to continue to expand. And this thought is beginning to sink in.

So the industry will welcome this national commercial leader in the N.E.L.A. It will follow him in any practical progressive program. He cannot come too soon.

* * * *

Make Manufacturing Profits Adequate

A BUYERS' market prevails in American industry. Manufacturers in general have had a favorable volume of business, but the cost of manufacture has not decreased as much as has the selling price of manufactured products. As a result the profits resulting from manufacture are disappointing. Buyers as a class have exerted their influence to get price reductions which are made possible by an excess in producing capacity. In many instances an increased volume of business has been obtained from competing manufacturers by lowering price levels, and this practice has interfered still further with profits.

The American business and commercial structure is sounder than ever before. Much of the slack has been taken out of industry, and manufacturers on the whole have reduced costs and simplified operations, thus arriving at a stable cost-of-production basis. What, then, can industry do to get adequate profits on what is manufactured? It would be unwise for manufacturers to attempt to control artificially the economic trend of the times. In theory consolidations could be made and thereby the producing capacity of the country diminished or prices controlled. But in practice there are decided limitations to such a plan, and in addition the country needs the present producing capacity if the market is sold. A better attitude is for manufacturers to cope with the situation by the adoption of economies and business practices which conform to the economic trends of the times.

Industry executives are looking toward several definite things which will improve manufacturing profits. They are giving more attention to financing and are reducing their indebtedness and checking expenditures more closely. In some lines, at least, an export business is being developed, because mass production and modern methods more than offset low wages and prices in foreign countries. The chief hope lies in market development.

Electricity is the key to the internal situation. Electric power and electric equipment reduce labor charges. New processes in manufacture have come over the horizon through the use of electricity in many forms. Electrodeposition has come into play to produce purer metals, to reclaim waste rubber, to reclaim metals from ore dumps. Electric fields are commercial prospects to precipitate oil from gas, chemicals and minerals from smelter and roaster fumes and to secure solids of many

kinds from distillation processes. Electric heat has proved a boon to many industries; it has a permissible range in temperature—which is very great and gives extreme accuracy in control—and, in addition, it has an adaptability to production equipment, which has created revolutionary changes in the brass industry, the machine-tool industry, the foundry, the automobile plant, the textile mill and other basic manufacturing processes. It is not yet developed or applied on a scale sufficient to indicate any degree of saturation. The electric furnace and the possible electric production processes for dealing with minerals and earths offer a most fruitful field of study. Electric light as a direct agent, as a catalyst and as an aid to improved working conditions has not been fully exploited. The X-ray, ultra-violet rays and other radiations produced by electricity are recent innovations in the commercial realm which offer great possibilities.

Further use of electricity, the adoption of a greater degree of standardization and the development of a better organization for manufacture and sales are the things American industry is doing to better profits, and the greatest hope lies in using electricity in new ways and in new forms and in developing existing markets.

* * * *

A Business Point of View on the Outdoor Substation

CONSIDER the outdoor substation. To the power-company engineer it is a thing of transformers, switches, busbars, insulators and steel structure. But to the men and women who pass by it is the outward and visible sign of the presence of the public utility, a recurrent reminder of its good service or its unpopularity, as the case may be. The very nakedness of this cold, mysterious-looking skeleton suggests the deadly nature of electricity, when it goes wrong. Involuntarily they note that only a woven fence intervenes between them and the wicked wires. It is perfectly obvious, therefore, that the less brazen the thing appears, the less harsh and offensive it looks, the better it is for public relations in that town. For even physical property is a factor in winning public approval and making friends—for the simple reason that if it is attractive it does not repel.

How many outdoor substations there are about the country that look like last year's bird nests. Careless in design, sloppy in construction, naturally cheerless in their exposure and abandoned in unkempt surroundings, they stand as scars on the landscape, whose grotesque outlines capture the eye and leave a lingering impression that is not pleasant. And yet a little care, a little thought would have transformed each of them into a good-looking structure that need have cost no more, graced by a bit of lawn, a hedge, some shrubbery, and perhaps an attractive sign that would inform the observer that this modern substation provides electric service to the homes and industries of that locality. And what would the reaction be then? Public attention would not center on the rugged outline of the transformers or pause in awe upon the row of insulators. The eye would rest with pleasure on the greenery, read the good-service message on the sign and carry away the memory of a well-kept property. Men would speak of it as the latest thing in the power business, the mark of a progressive service company. This kind of a substation builds good will. And good will is worth as much in a small community as in the big town.

Electrodeposition of Rubber Now Possible

SCIENTIFIC research has placed another tool in the hands of industry. In a recent paper Dr. S. E. Shepherd outlined the research which has made it possible to bring about the electrodeposition of rubber. Suspended particles of rubber are negatively charged and, under the influence of an electric field, can be moved to the anode and made to form any desired shape or thickness of rubber product. The latex in which the rubber particles are suspended may be the natural fluid from the rubber tree or may be an artificial latex made by masticating reclaimed rubber with glue and water. The anode used is zinc in order to remove the oxygen. This process bids fair to revolutionize rubber production. Instead of mixing and grinding dry materials in an intermittent process with consequent power requirements and loss of time, it will be possible to use a wet-mix continuous process to produce tires and other rubber products. Another advantage is that any desired rubber compound may be made and that old rubber can be used freely and resuscitated, so to speak, into its original quality.

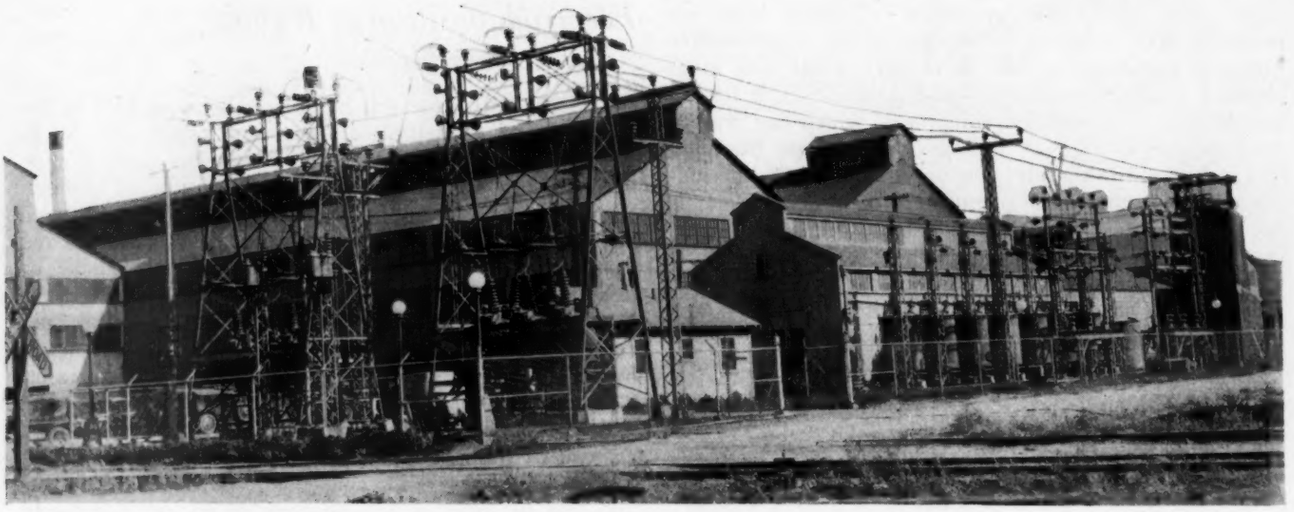
A definite application of importance to the electrical industry suggests itself. Copper wire may be zinc-dipped and then covered with rubber by the electrolytic process, thereby getting a rubber of very high dielectric strength or a rubber compound of any desired characteristics. A second suggestion from the research of Dr. Shepherd is that possibly oil troubles in cables and breakers may be understood better by researches into the influence of an electric field on colloidal oils.

* * * *

Sales Efforts Should Be Continuous

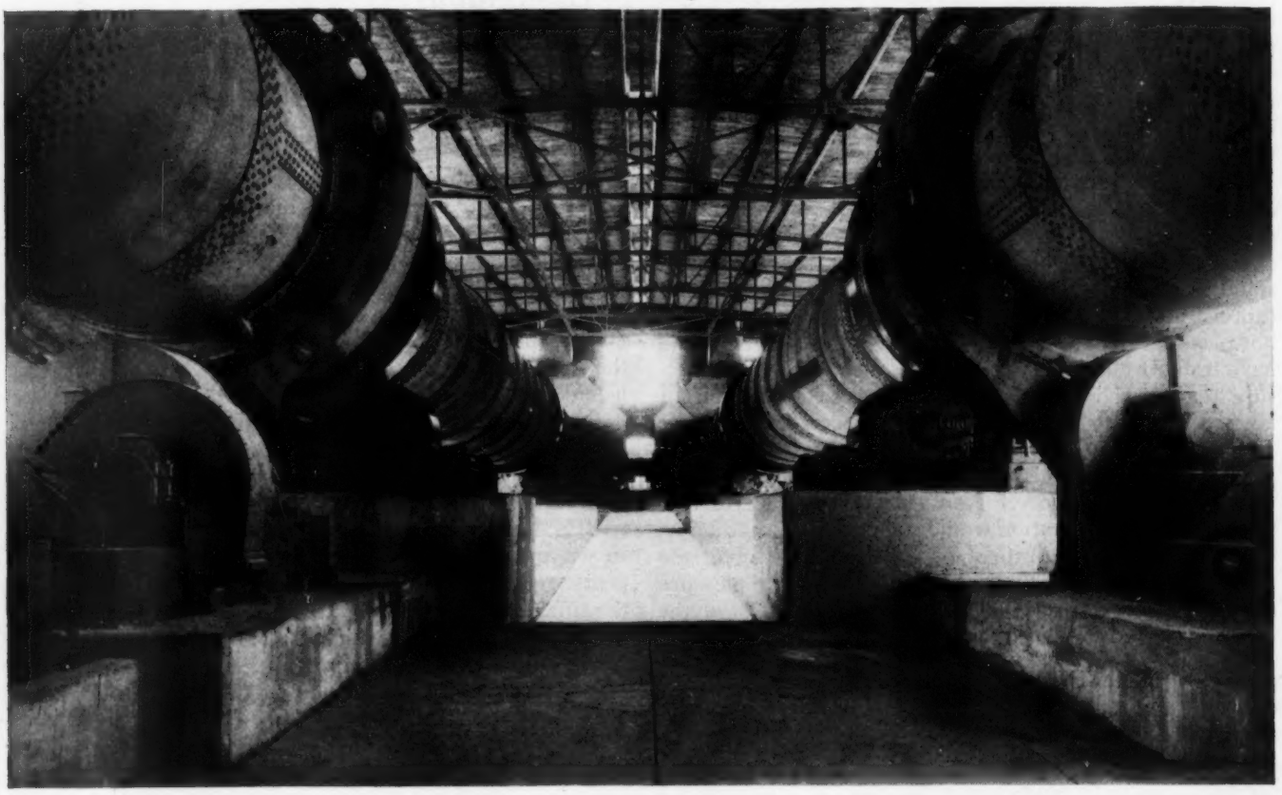
THE job of the power salesman is not finished when he marches with triumphant feet into the general manager's office, clutching in his fist a contract for power supply, signed, sealed and delivered. He has only achieved a fair start. This statement is not new in the ears of the men who manage central-station companies. A lot of them have made remarks of the same tenor themselves. But the obvious things are often the neglected ones. The same vice-president who tells his fellow vice-presidents in convention assembled that a power salesman's work lies as much in keeping customers as in getting them will go back home and completely eviscerate the sales department budget. He talked, but he did not listen to what he was saying.

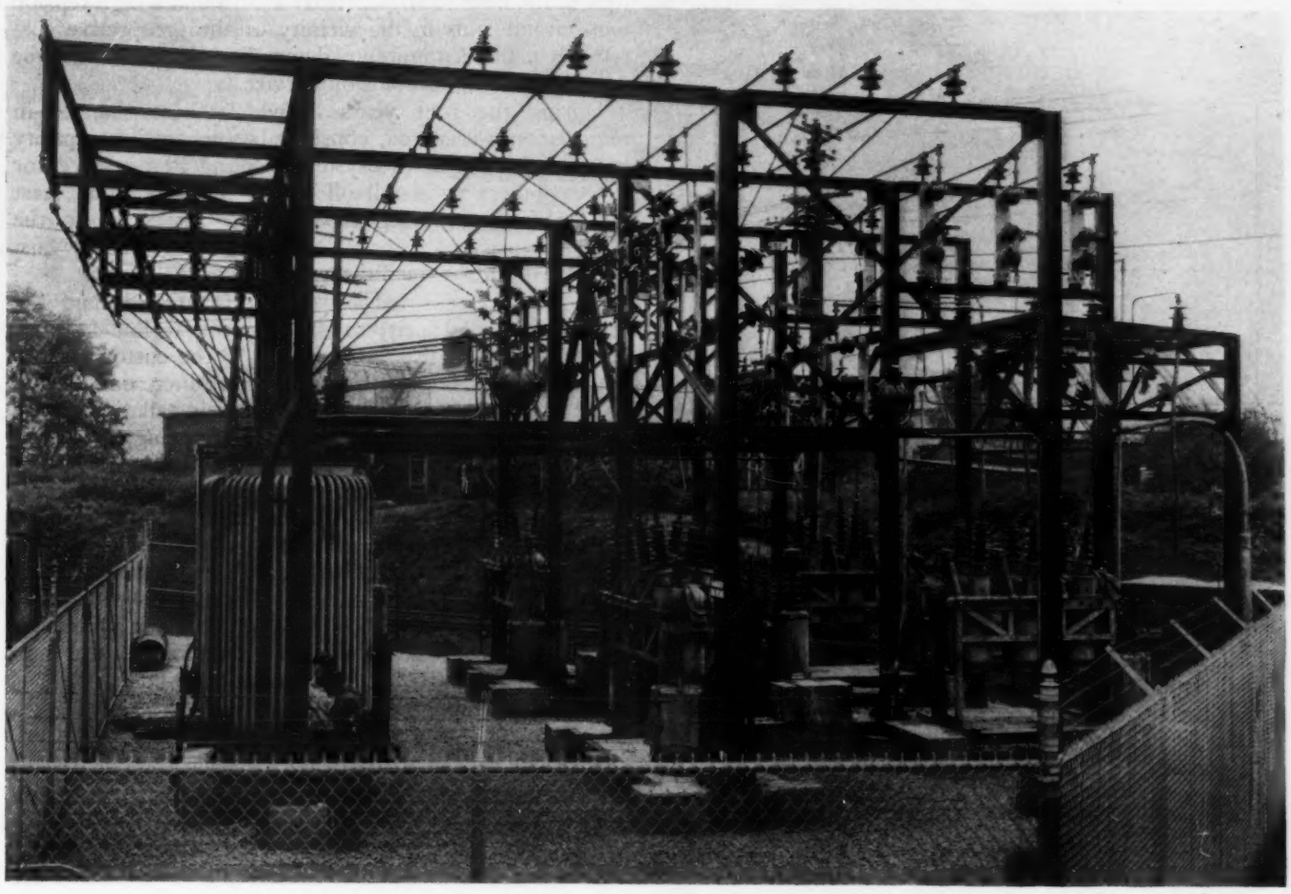
From the very fact that it, to an extent, enjoys monopolistic privileges, it is incumbent upon the central station to do the very best kind of a selling job in every class of service. The customer who regards the electricity supply company as having a monopoly is quick to see and quick to resent any condition in which it appears, rightly or wrongly, that the company is taking an advantage. This is true of all classes of customers. In the industrial field, in which central-station monopoly of power supply most emphatically does not exist, but where even those who prove its non-existence accept it as an actual condition, the selling effort of the light and power company must be unceasing and devoted even after every potential customer has come into the fold.



Service To and Within Industry

IT IS FREELY admitted by industrial executives that electrical applications and control have been the outstanding factors in enabling the individual worker to produce more without detracting from the quality of his output. Leaders of labor organizations, both domestic and foreign, have ascribed the enviable position of American labor largely to the same development. For these reasons, and because the electric light and power industry has the opportunity to expand still further these benefits at profit to itself, this issue of the ELECTRICAL WORLD is devoted to "Service To and Within Industry." Emphasis is placed on design, layout and construction methods which will permit the most reliable service, provide promptly for individual or collective industry expansion, promote economical use of electricity in industrial processes, and enable workers to control power rather than furnish it.





SPECIAL INDUSTRIAL SUBSTATION MEETING AREA LIMITATION REQUIREMENTS

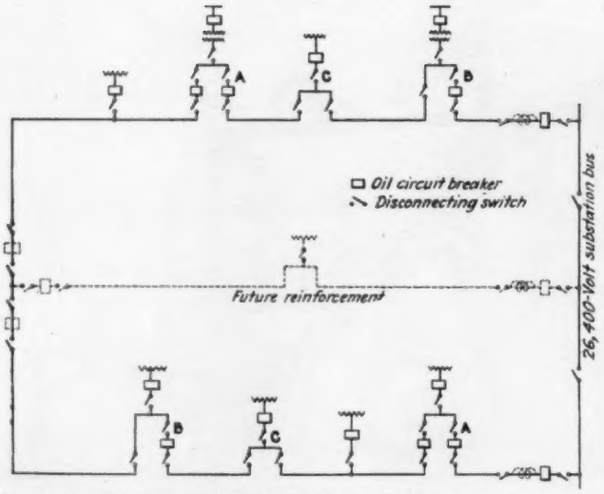
High-Tension Service *for* Industrial Customers

By OSCAR BAUHAN
Engineer Distribution Department
Public Service Electric & Gas Company

Looped circuits, automatic and semi-automatic protection at consumer's substations and company supervision of operation prove value

ABOUT eight years ago the Public Service Electric & Gas Company began selling 13,000-volt or 26,000-volt service to power customers having a demand of 500 kva. or more. The company's rules state that the customer is to stand the cost of all labor and material necessary to complete the service connection in or on his premises, exclusive of the meter and metering transformer and the installation thereof. These facilities were at that time relatively simple, since the high-tension feed usually consisted of a tap from a regular station-to-station line and nothing more than fuses was required for protection.

Due to interruptions on the regular line resulting from customer's faults or faults on the regular line giving interruptions to the customer's service, the arrangement was not considered satisfactory and it was decided to isolate all customers from regular station-to-station lines and erect new lines for customer service only. This change involved considerable expenditure and when the low-tension distribution system was changed to 4,150-volt, three-phase, about four years later, the whole problem of giving customers 13,200-volt or 26,400-volt service was reconsidered and the relative advantages of the contemplated standardization received further attention.



TYPICAL LOOP CIRCUIT FOR SERVING INDUSTRIAL LOADS

Full automatic service may be obtained as at *A*. Non-automatic service with one oil circuit breaker is shown at *C*. *B* is a compromise requiring momentary interruption in case of failure on the station side of the line. This loop may be sectionalized by oil circuit breakers when the reinforcement feeder is added.

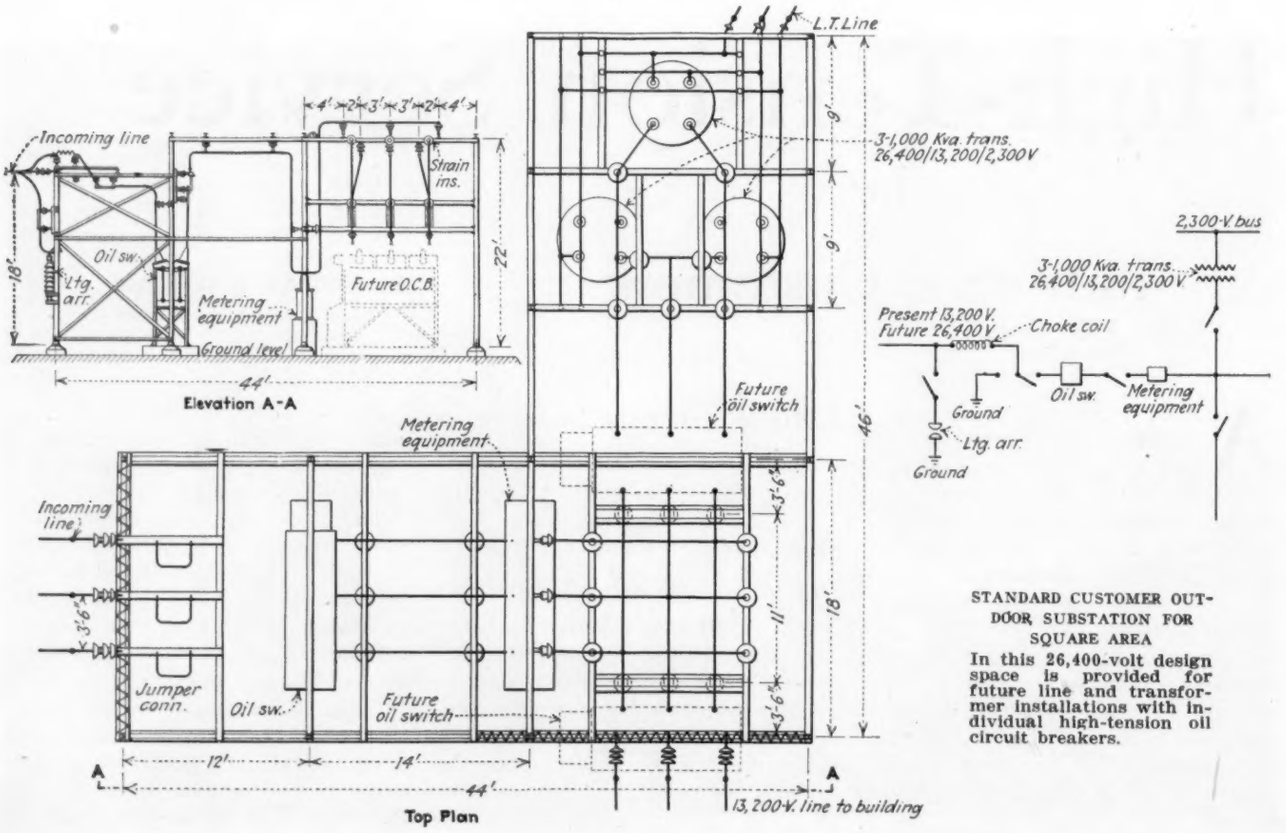
Under the three-phase distribution system a load of 2,000 kva. could be carried on one circuit having a maximum rating of 300 amp., loads beyond that amount requiring the installation of a second parallel feeder. With this in mind, the type of service to be supplied to any power customer would be determined by *(a)* the location of that customer with respect to available power, *(b)* the initial demand and *(c)* the growth of the load. Each application receives individual study and where either 4,150 volts three phase or 26,000 volts are equally available, the high-tension service is supplied if the minimum initial demand is to be 2,000 kva. or will exceed that in the near future. When a customer's high-tension loop circuit runs in the vicinity of the prospective customer's plant, a minimum demand of 500 kva. may be considered for high-tension service.

During the four years in which these changes in requirements occurred, considerable generating capacity had been added to the system, making it necessary for the customers to install oil circuit breakers of at least 500,000-kva. rupturing capacity for protection to the system in place of fuses. This change increased the cost of the substation facilities.

Customers were fed by single radial lines and the service was only partly satisfactory due to line failures, with ensuing lengthy interruptions to the customer. As the number of high-tension customers increased in and about a given load center, the new installations were connected by looping the line through existing customers' substations. Gradually several of these loops were completed by bringing the end of the line back to the companies' substation bus. In operation the loop is open at one point to facilitate the location of faults in case of failure, and service can be restored in a relatively short time. This type of service is classified as emergency rather than duplicate feed. Where automatic protection is desired, oil circuit breakers are required on the loop as well as on the tap to the transformer bus.

Looped Circuits

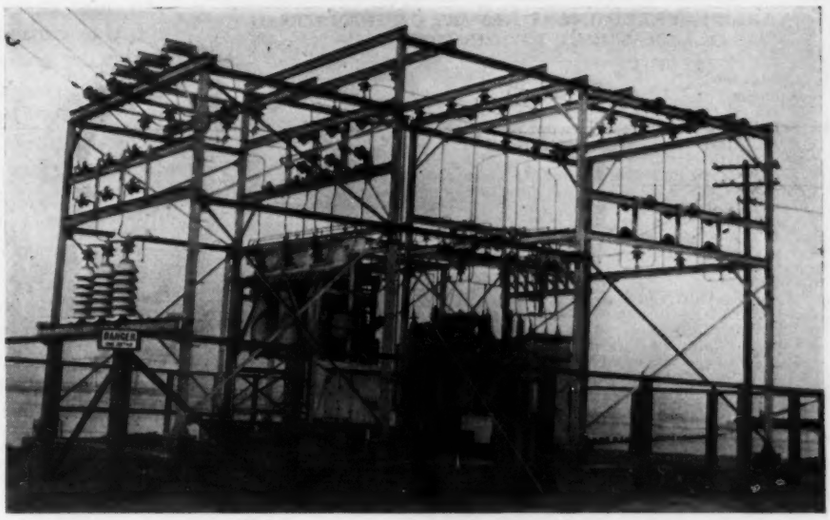
A typical loop is illustrated on which customers having various methods of protection are located. Substations marked *A* cover the case of full automatic protection with oil circuit breakers in the loop as well as on the high-tension lead to the transformer. Occasionally, where oil circuit breakers are installed in the lines, the company has been willing to accept the hazard of a trans-



STANDARD CUSTOMER OUTDOOR SUBSTATION FOR SQUARE AREA

In this 26,400-volt design space is provided for future line and transformer installations with individual high-tension oil circuit breakers.

former failure and has consented to the elimination of the transformer high-tension oil circuit breaker. Under this arrangement the company specifies the transformer secondary oil circuit breaker as to type and rating in order that the high-tension line may be reasonably well protected against faults originating in the customer's plant. This can be effected only in extremely few cases, since usually either it is impossible to obtain an oil circuit breaker of sufficiently large short-circuit rating or the installation as a whole is more expensive than an oil circuit breaker on the high-tension side of the transformer. *B* represents installations where one oil circuit breaker has been placed in the line. This arrangement gives the customer automatic protection against faults on one side of the loop but no protection against faults on the other side. The expense of such an installation is out of proportion to the protection afforded, and in general it is much more satisfactory for the customer to spend the additional amount necessary to obtain the arrangement described under *A*. *C* shows the general case of disconnecting switches with one oil circuit breaker placed on the high-tension side of the transformer. The dotted line in this figure shows the reinforcement planned for the loop, to be installed when the capacity of the line is exceeded. Customers may be connected to the reinforcing line.



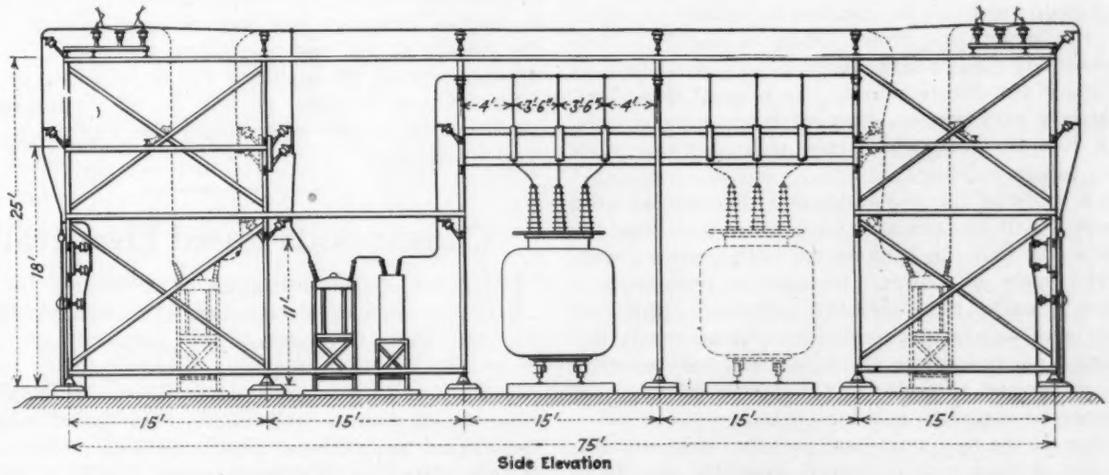
SIMPLE HIGH-TENSION SUBSTATION THAT CAN BE EXPANDED
This installation feeds one 3,000-kva. transformer bank and an electric furnace.

Design of Substations

When these installations were first made on the system, sufficient attention was not given to details of the substation design as effecting voltage regulation, raising or lowering of the transmission voltage due to rearrangement of the transmission system, or future load requirements. With regard to voltage regulation and future requirements, the word of the customer's engineer was accepted, since it was assumed that he would be better informed than the company's engineers regarding the needs of the plant. As a result of this, some complaints have been received from customers concerning low working voltage or burned-out lamps due to high voltage at night. In some cases the customer failed to realize, or underestimated, his future requirements, and it seemed that a serious error had been made when, to carry the additional load brought about by plant enlargement, it was necessary practically to write off the investment in a $10,000 installation completed but three or four years previously.

Close co-operation between the customer and the power company is needed to meet this situation. The company at all times stands willing to give the customer the benefit of its experience in constructing high-tension installations. Too much importance cannot be placed on the necessity of company engineers obtaining as much knowledge as possible of the requirements of service for the various processes. On the other hand, an effort should be made to have the customer understand the problems involved in furnishing that service. It is only in this way that the installation can be made of real benefit to both the customer and the power company and an amicable arrangement can be secured.

At the time the application for high-tension service is approved the customer is visited by the local power



STANDARD CUSTOMER OUTDOOR SUBSTATION FOR RECTANGULAR AREA
Type of structure adaptable to a long, narrow strip of land. Provision for future line oil circuit breakers has been allowed.

TABLE I—PRELIMINARY REPORT ON INDUSTRIAL CUSTOMER REQUIREMENTS

1.	Customer		
	Address		
	Division		
2.	Service to be supplied at approximately —— volts by item ——		
	1. Radially from —— substation		
	2. Tap to circuit ——		
	3. Loop through disconnecting switches on circuit ——		
	4. Loop through oil circuit breakers on circuit ——		
3.	Total load to be served	Connected	Demand
	Lighting	Kw.	Kw.
	Synchronous motors or converters	Kva.	Kw.
	All other load	Hp.	Kw.
	Total maximum demand		Kw.
	Power factor of maximum demand		Per Cent
	Minimum low-tension bus voltage satisfactory for plant operation		Volts
	Probable minimum demand		Kw.
	Power factor of minimum demand		Per Cent
	Maximum low-tension bus voltage permissible during light load periods		Volts
	Type of service on low-tension bus		Phase
	What is estimated customer's feeder drop?		Volts
	What is rated nameplate voltage of load?		Volts
4.	Is installation new—that is, not replacing other electric service of any kind?		
5.	Is installation replacing an isolated plant or other type of company service?		
6.	Is complete or only partial service to be furnished customer?		
7.	Is customer's plant to be abandoned?		
8.	Portion of present* load to be served:	Connected	Demand
	Lighting	Kw.	Kw.
	Synchronous motors or converters	Kva.	Kw.
	All other load	Hp.	Kw.
	Present maximum demand		Kw.
	Power factor of present maximum demand		Per Cent
	Present minimum low-tension bus voltage		Volts
	Present minimum demand		Kw.
	Power factor of present minimum demand		Per Cent
	Present maximum low-tension bus voltage permissible		Volts
	Present frequency		Cycles
	Present maximum feeder drop		Volts
	*Present refers to actual readings.		
9.	New connected load to be served	Connected	Demand
	Lighting	Kw.	Kw.
	Synchronous motors or converters	Kva.	Kw.
	All other load	Hp.	Kw.
10.	Total of present load and new load to be reported in section 3 of questionnaire.		

representative, in company with the local distribution engineer, and is asked to fill out a questionnaire covering the various service requirements. With this information as a basis, and after conference with the customer's engineers, an adequate substation is designed and the various requirements are submitted as a suggested plan. In the usual case a standard substation similar to that shown can be applied. All indoor installations are considered as special, and of course the outdoor standards are not always applicable, due to the necessary land not being available. Where these special installations are made, standards of electrical spacing and equipment are adhered to as closely as possible.

The substation in general is laid out in such a way that additional lines and transformers with the necessary switching equipment can be installed by adding standard units to the structure. Every effort is made to have the customer lay aside a sufficiently large plot of land to provide space for future needs. As a usual thing this is a relatively easy matter, since in most instances the customer has his property pretty well laid out with regard to future buildings.

When a study of the loads indicates that one bank of transformers will be sufficient for present and near future needs and that the bank is not supplemented with any other source of power, single-phase units with a spare are usually recommended. Voltage taps are chosen to give satisfactory regulation for all conditions of loading and power system operation, but in some cases it has seemed advisable to recommend that a small transformer be installed, in addition to the power bank, to take care of the minimum load periods. The installation of this smaller transformer is desirable also from the standpoint of reducing transformer losses during the non-productive hours of the day.

In most cases one oil circuit breaker of 500,000-kva. rupturing capacity and approved type is required on the lead to the transformer bank. Under this arrangement the company does not attempt to specify the characteristics of the low-voltage equipment so long as that equipment meets certain standards of safety. High-tension oil circuit breakers must be equipped with automatic trip but may be hand operated where no reliable closing current is available. In such cases tripping current is derived from a standard 12-volt automobile battery. Where only one oil circuit breaker is to be used, relays are installed for overload phase and ground protection, but when breakers are placed in the lines as well as in the transformer tap, relays must be installed to give directional phase and ground protection. This necessitates the installation of potential transformers.

The incoming line is equipped with disconnecting switches for short circuit and ground. All conductors are spaced 3 ft. between phases and 18 in. between phase and ground. Insulators have nominal ratings of 37,000 volts, with a 60-cycle wet flashover value of 84,000 volts. The customer is advised to provide and install every accessory making for safety. Steel column grounds should be protected from physical injury.

These recommendations, together with preliminary drawings giving the general character of the proposed installation, are sent to the customer purely as a suggestion. The customer is then at liberty to go to any contractor he sees fit to carry out the work. The majority of installations so constructed have been successful, but there have been times when the contractor has taken extreme liberties and nullified such things as the adaptability of the structure to future expansion.

Operation

The system load dispatcher has control over all high-tension lines on the system and any operation of disconnecting switches or oil circuit breakers in customers' substations must be performed under his orders. The greatest facility of operation can, of course, be effected by the load dispatcher establishing telephonic communication directly with the customer and having the customer perform the necessary operation. As a rule, in the past this applied to oil circuit breakers only and it was necessary for the load dispatcher to get in touch with one of the company's maintenance men to perform the operation of disconnecting switches. This led to considerable delay in re-establishing service and the method of operation has been changed so that when, in the opinion of the load dispatcher, the customer's operators are capable, the customer will be permitted to operate disconnecting switches as well as oil circuit breakers. Such operations are made under the supervision of the load dispatcher.

Caustic Soda Fused Electrically

THE successful utilization of a process for fusing caustic soda by electric heat is expected to save the Riordan Pulp Corporation, of Timiskaming, Quebec, more than $10,000 annually. Electrolytically produced chlorine has a byproduct, when produced from sodium chloride, of sodium hydroxide. This latter material is then fused in 2,600-gal. pots by 500-kw., 550-volt heating elements. In a 50-hour period 30,000 lb. of caustic soda may be produced with an average power requirement of 1,350 kw.-hr. per ton.

NEED FOR POWER WAS SO URGENT THAT MOTOR-DRIVEN COMPRESSORS WERE INSTALLED FOR PUMPING OIL BEFORE HOUSINGS WERE ERECTED

Rushing Power to Meet New Oil Field Demand

A dramatic but nevertheless practical story of how an Oklahoma utility provided for a load of 30,000 kw. in the recently developed Seminole field

By R. F. DANNER
General Superintendent Oklahoma Gas & Electric Company

JUST a little more than one year ago (July, 1926) the Independent-Garland Oil Company discovered the Wilcox sand and "brought in" the first big well in the Seminole oil field, approximately 1½ miles east of the town of Seminole, Okla. A few weeks later the Amerada Oil & Gas Company "brought in" a big producer approximately 1½ miles north of the Independent-Garland's discovery. The completion of the second producer made prospects excellent for a large pool of high-gravity crude, and by the middle of September there were approximately 100 wells being drilled by various oil companies in the vicinity of the two producing wells.

150 to 300 Hp. Per Well for Compressors

A few months before the discovery of the Seminole field the Oklahoma Gas & Electric Company had extended its lines from its Wewoka substation to supply the Amerada Oil & Gas Company with electric power for flowing with compressed gas the wells on the company's Wewoka lease. This method had proved so successful that Amerada signed a contract for electric power for its Seminole lease. Several other oil companies in the proven area either signed contracts for electric power or assured the company that they would use its service for pumping their wells when they were brought in.

Owing to the fact that the crude had a high gasoline content and would consequently bring a high price, the Amerada company announced its intention to install several motor-driven compressors, which it had on hand, and have them ready for use as soon as the natural flow from its first producing well began to decrease.

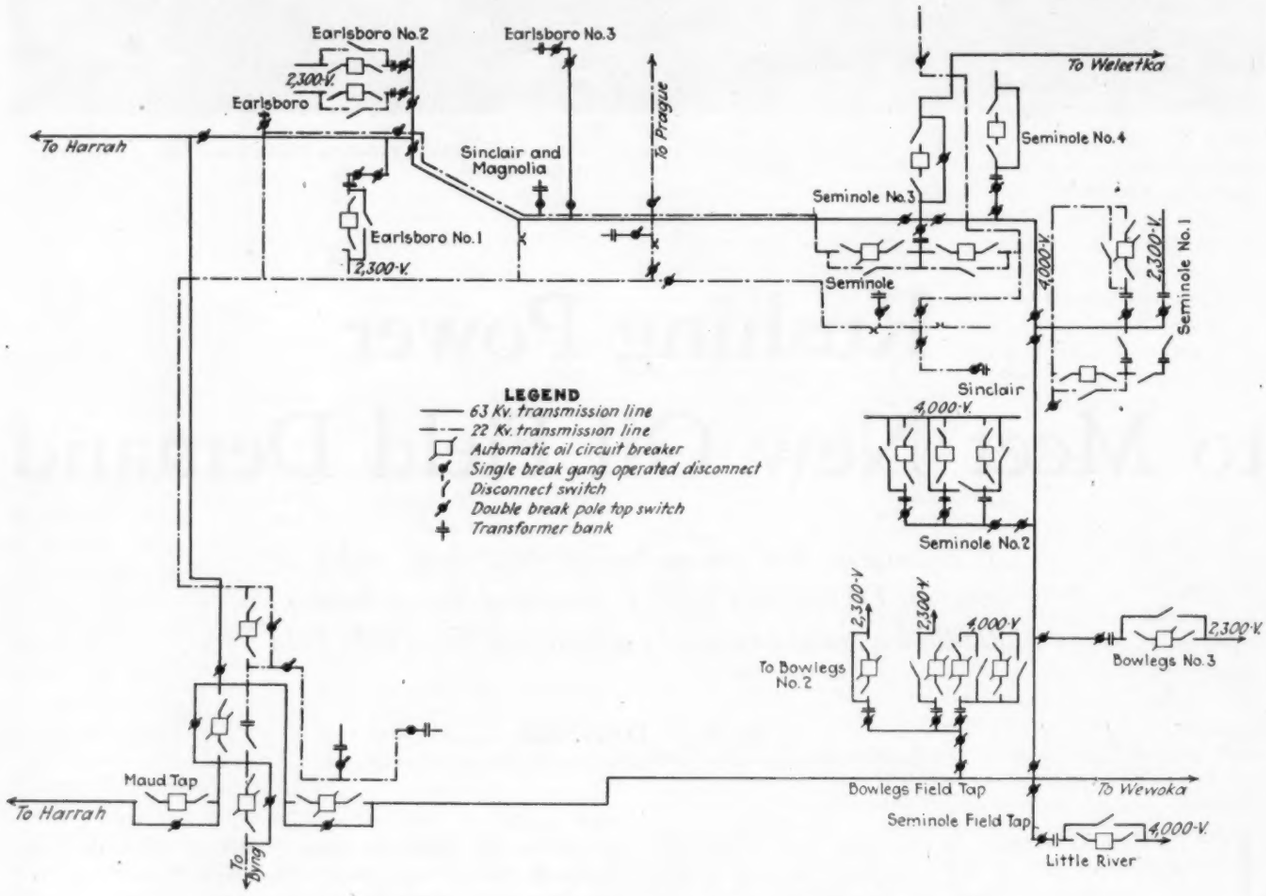
Before going further it should be explained that this method of pumping consists of compressing air or natural gas to a predetermined pressure and piping it from the compressor to the casinghead, where it enters the space between the tubing and the casing or else is applied inside the tubing. The air, or gas, flows down to the bottom of the casing, where, by reason of its pressure, it forces the oil to rise through the well tube and discharge into the flow tank. In other words, the wells are made to flow as they do from the gas pressure in the oil sand when they are first drilled. The power

required for this method ranges from 150 to 300 hp. per well and obviously the production is much more rapid than with the beam-pumping method.

Getting back to the story about taking care of the first load in the Seminole field, the Oklahoma Gas & Electric Company was serving the town of Seminole from a 13-kv. line of No. 6 copper conductor about 18 miles in length, which was supplied from the company's Maud-Tap 63/13-kv. step-down substation. Thus our nearest transmission line was only 1½ miles from the first two wells that were brought in.

The problem of supplying the power requirements for the prospective oil field came up for decision about the middle of September last year. As previously stated, power was wanted for flowing the first two wells when needed. No one knew whether the time allowed would be a matter of days or weeks. It depended on how long the gas pressure in the sand held up. However, we considered: First, if we expected the oil companies to use electric power, we must have it available when needed; second, it was evident that the air-gas lift would be used and that if this method were adopted by some of the oil companies, others would have to use it to obtain their share of the oil; third, that prospects were excellent for a major oil field; fourth, the load that could be transmitted into the field over the 13-kv. line would amount to only a few hundred kilowatts.

It was promptly decided to extend the 63-kv. transmission line into the field to insure sufficient capacity to take care of the prospective load. Material was immediately ordered for a 6-mile extension of the 63-kv. line from the 63-kv. line supplying Wewoka and the construction of a 1,500-kva. substation. As it was realized that it would take from 30 to 45 days to get the 63-kv. extension in service, it was decided to extend the 13-kv. line from Maud east approximately 2 miles into the field to take care of such load as might come on before the 63-kv. line and substation could be completed. As we had sufficient material in stock for the 13-kv. extension, it was completed in about two weeks. In the meantime drilling of additional wells was being started daily. At the time we announced that we would supply electric power for pumping, about 100 wells were being pushed with feverish haste, day and night, with rotary rigs toward the sand, which in this field is approximately 4,200 ft. deep.



LOOPED FEED AND PROTECTIVE DEVICES FOR SERVING GREATER SEMINOLE OIL FIELD

Before the 63-kv. extension was well under way the load began to come on. It was not many days before we had to resort to star connection of the transformers on the 13-kv. side at the Maud-Tap substation and at other substations on this line, thus converting it to a 22-kv. circuit, to maintain satisfactory voltage.

New wells were being brought in almost every day, resulting in a rapid decline of the gas pressure and subsequent reduction of the natural flow of oil from the wells.

As the additional production that could be obtained from the use of compressors to flow a well would pay for a compressor in a couple of days, the installation of compressor plants was rushed by the oil companies.

They ordered motors and compressors by express, and had crews working 24 hours a day constructing the stations.

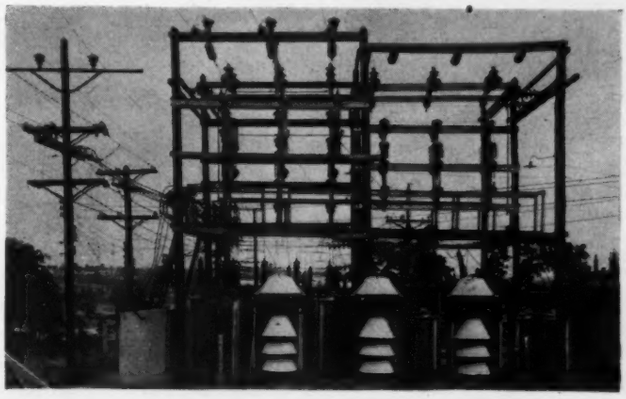
It became a question as to whether we would be able to get the 63-kv. line and substation in service before our 22-kv. line became overloaded. In the meantime we had taken three 333-kva. transformers that had been released from another substation on our system and installed them at Maud-Tap substation in parallel with the three 200-kva. transformers that had become overloaded.

Pending the arrival of the poles for the 63-kv. line, work was started on the 63-kv. substation. A wood-pole structure was built and three 500-kva., 63,000/13,800-2,300-volt transformers on hand were installed. Transformers and switching equipment had been ordered, from about 1,200 to something like 6,000 in a few weeks, the line crews could not find living quarters. Therefore we bought a large tent and a number of cots and established an improvised camp at our Seminole No. 1 substation site.

Living and working conditions were wretched, but the men realized the problems we had and worked faithfully without complaint in spite of the hardships.

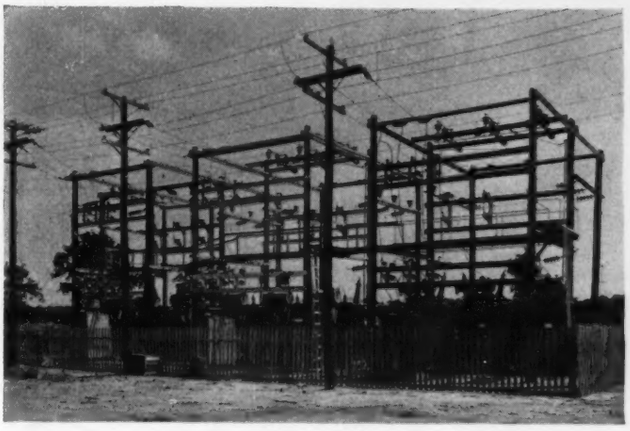
The first bank of three 500-kva. transformers was cut in on Nov. 19, 1926, and connected for 22 kv. on the secondary side to relieve the 22-kv. line, supplied from Maud-Tap, of its overload. Before the first project had been completed it was evident that more substation capacity would be needed, and two additional banks of transformers, one 2,000-kva. and the other

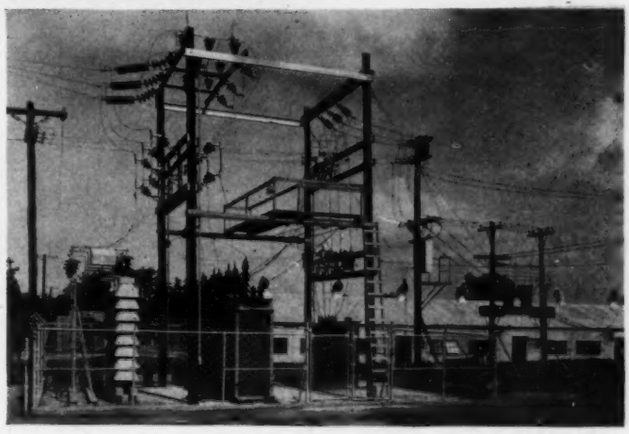
Seminole No. 1 substation (shown at the right) was the first constructed in the Greater Seminole field and had to be equipped and erected under the most pressing circumstances; this station contains 7,000 kva.



Seminole No. 2 substation (shown at bottom, left) was next to be put in service and contains some equipment originally planned but unavailable for No. 1. It is rated at 7,500 kva. Additions are made in bays.

Bowlegs No. 3 substation (shown at bottom, right) was a still later and more typical 63,000/4,000 installation, rated at 1,500 kva. The metering equipment is housed in metal cabinet on pole.





THREE 63,000/4,000-VOLT OIL FIELD SUBSTATIONS BUILT AT SUCCESSIVE STAGES IN DEVELOPMENT

but as we did not have time to wait for them to arrive, we had to use material that could be secured from stock.

In about three weeks the poles for the 6 miles of 63-kv. line arrived and we immediately began construction of the line, using wire, insulators and crossarms that we had in stock.

Rainy weather handicapped construction seriously, as it made the dirt roads practically impassable. When the drilling activity was at its peak, the roads became so badly cut up during rainy weather that at times only teams and caterpillar tractors could traverse them. Even during good weather traffic was so heavy that much time was required to haul material from Seminole, the nearest railroad point, to the field. It was a common occurrence to be stalled for half an hour on account of a traffic jam or to wait an hour or more to get across a narrow bridge on the highway.

As the town of Seminole had increased in population 2,500-kva. were ordered. Automatic reclosing switches and other substation equipment, also needed, were ordered. However, before these transformers and the other equipment were received the 1,500 kva. substation was loaded to capacity. The load was steadily increasing, and to meet the situation, pending the arrival of transformers on order, use was made of all spare transformers and changes were made in other substations, releasing two 1,500-kva. banks and one 2,000-kva. bank, which were installed in Seminole No. 1 substation.

By the time the first bank of transformers was installed in Seminole No. 1 substation it became apparent that the load density would be so high that it would be economical to make one transformation from 63,000 to 4,000 volts to distribute at 4,000 volts instead of 13 kv. or 22 kv. as originally planned. Therefore 4-kv. distribution lines were constructed and the additional transformers installed in Seminole No. 1 substation were

FOUR 200-HP. INDUCTION MOTORS IN PIPE-LINE PUMPING STATION HANDLING 40,000 BBL. PER DAY
The pumps are on other side of partition from motors.

connected for 4-kv. operation on the low-tension side.

The last installation at this substation left us without even a spare transformer, and the field had been extended south so far that another substation was needed to handle the load. Work was therefore started on Seminole No. 2 substation. By the time service from this new station was needed we received a bank of three 833-kva. transformers, which were the transformers that were ordered at the time we decided to extend our line into the Seminole field. The capacity of this substation has been increased as the load required until it now has three 2,500-kva. transformer banks.

Before the first of January, 1927, oil had been discovered in the Bowlegs and Earlsboro areas, north of the Seminole field.

Owing to the rapid increase in the oil-field load, it was apparent early in February, 1927, that additional generating capacity should be provided. The Horseshoe Lake generating station, the largest central station on the system, is north of the field and the Byng generating station is on the south. Practically all the power requirements were being supplied from the Horseshoe Lake station, as the Byng station capacity was only 5,000 kva. It was evident that proper voltage could not be maintained with the expected increase in the oil-field load, on account of the voltage drop in the line from Horseshoe Lake station to the field. Furthermore, the generating capacity at Horseshoe Lake was becoming gradually loaded. In order to provide the additional generating capacity at Byng power station, and do it quickly, it was decided to secure two 6,000-kva. turbo-generators with necessary boilers and auxiliary equipment from the Northern States Power Company and install them at Byng. A remarkable record was made in the extension of this plant by the construction department of the Byllesby Engineering & Management Corporation, in that it was only 84 days until the first unit was in operation and 105 days until the second unit was in operation, after excavation for the turbine-room portion of the building was started on Feb. 21.

Further to insure continuity of service to the Greater Seminole field a new 63-kv., No. 3/0 copper transmission line was constructed from Horseshoe Lake generating station to the Maud-Tap substation. This transmission line, which is 48 miles in length and constructed on 45-ft. creosoted pine poles spaced 300 ft. apart, was placed in service in July.

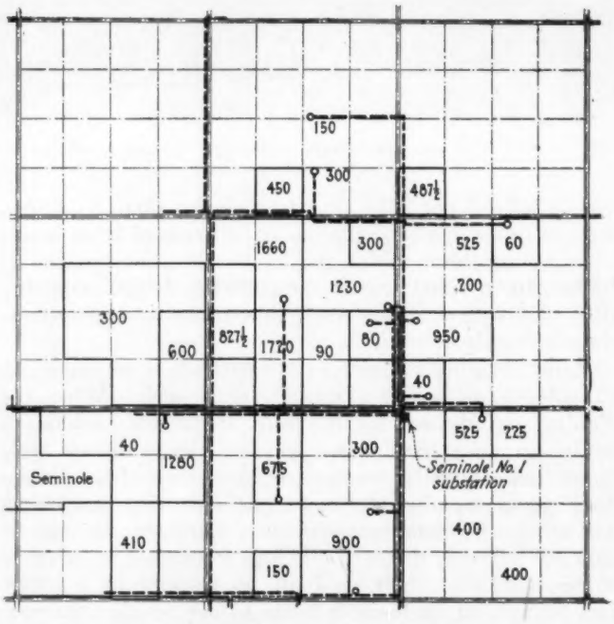
A Systematic Distribution Layout Followed

As previously stated, the plan of distribution at 4,000 volts has been followed as far as possible. The 4-kv. distribution lines are constructed along the section lines. The type of construction used is as follows: No. 3/0 bare-copper conductor, 8-ft. wood crossarms, and 35-ft. poles, spaced 275 to 300 ft. apart. Where the load is sufficient to justify it, the 4-kv. lines are closed around the section lines to obtain maximum capacity from the circuits and to provide two sources of supply. Air-break disconnect switches are installed at various places in the 4-kv. loop circuits for sectionalizing purposes, so that in case of trouble on some section of the circuit, that section can be quickly cut out and service restored on the rest of the circuit.

The 4-kv. circuits are controlled at the 63/4-kv. step-down substations by automatic reclosing oil circuit breakers of 400 and 600 amp. capacity. A watt-hour meter and chart-type demand meter are installed in each of the switch houses, so that a careful check can be kept of the load on each circuit, and also on the substation.

The transformers in the step-down substations are connected delta on the 63-kv. side and star on the 2,300-volt side. The neutral on the low-tension side is solidly grounded at the substation. The oil companies construct their own 4-kv. three-wire distribution systems, which are connected to our 4-kv. lines at the section lines. The service is metered at this point. One of the metering equipments, which are housed in a galvanized sheet-iron box, mounted on poles, can be seen in the illustration of the Bowlegs No. 3 substation. The oil companies also furnish the 2,300/440-volt transformers to step down from 4,000 to 440 volts. The neutrals of the oil companies' transformer banks are not grounded.

With the exception of Seminole No. 1 substation, which was built with such material and equipment as



CONCENTRATION OF OIL WELL DRILLING AND PUMPING IN JUST ONE TOWNSHIP. FIGURES INDICATE HORSEPOWER

were available at the time, the substations were constructed in accordance with a standard substation design prepared by the engineering department of the Byllesby Engineering & Management Corporation. The Bowlegs No. 3 Substation is a typical example of a single-transformer bank type. When additional capacity is required, more bays are added as shown in Seminole No. 2.

At the third 63-kv. substation constructed near Seminole the company maintains its oil-field headquarters. Here there are six cottages, which were constructed for the foremen, meter men and the substation operator. Also at this location are a store room and a bunk house that will accommodate 26 men.

The Oklahoma Gas & Electric Company is the only company supplying electric service in the Seminole field. Some idea of the enormous size of this "wonder oil field of the world" may be gained when it is understood that the Seminole field produces nearly one-ninth of all the oil produced in the United States. More petroleum was produced from Oklahoma wells during July than any other state ever before produced in any month. Even with reduction, by agreement, in the Seminole field, nearly 500,000 bbl. is now being produced there daily.

With the discovery of oil in large quantities, towns spring up over night and demand electric and power service. And they want it immediately in several widely

ONE OF MANY MOTOR-DRIVEN COMPRESSOR STATIONS FOR FLOWING WELLS IN GREATER SEMINOLE OIL FIELD
There are fourteen 100-hp. motors driving compressors in this station.

Operators are kept on duty at all times at the more important substations so they will be available for switching or replacing fuses, or whatever may be necessary to restore service on a moment's notice. At the larger substations a cottage is provided for the operator. These cottages are constructed in sections, and can therefore readily be taken apart and reassembled, if it is desired to move them to some other location later.

At each substation there is a telephone connected to the company's private telephone line, which is connected into the load dispatcher's office at Oklahoma city.

In the comparatively short period of one year the load comprising the cities of Shawnee, Holdenville and Wewoka and the Greater Seminole oil fields has increased from about 3,000 kw. demand to approximately 31,000 kw. demand. This is mostly composed of compressor stations and pipe-line pumping plants, such as those shown in the illustrations, many of which have a load factor of from 80 to 90 per cent. The high load factor character of the business is shown by the fact that the demand amounts to approximately 25,000 kw. during the hours from midnight to 6 a.m., with a maximum peak during the day of approximately 31,000 kw.

scattered sections of the area at the same time. The construction department was taxed to its utmost to fill these demands. In a little more than a year there have been approximately 130 miles of line constructed, 30 substations built, a central station tripled in capacity, houses and store rooms constructed, offices in several towns installed, and many miles of distribution line put in service.

Electric Water Heating on a Large Scale Proves Economical

THE Valier Coal Company, of Valier, Ill., recently adopted electric heat for heating bath water for employees who are at work on days when most of the force is idle. The water is heated in a 235-gal. heat-insulated hot-water tank by six 5,000-watt, 220-volt helicoil sheath-wire immersion heating units and reaches utilization temperature within three minutes. Thermostatic control is used. The cost of steam operation on either workdays or idle periods is $34.25 per day, while that of electric heat, used on idle days, is only $7.64, which means a saving of $26.61.

Loop Cable System Insures

Reliable Industrial Power Supply

Fall River Electric Light Company plans progressive development of feeder layouts to supply widely separated mills—Effective relay installation

FIFTEEN years ago the Fall River (Mass.) Electric Light Company was supplying industrial power through 2,300-volt, three-phase, three-wire underground feeder circuits to a comparatively small number of customers. The electrification of the large textile mills of the city began to attain headway about that time with the motorization of the Pilgrim Mills, and to meet the expanding load requirements the company adopted the 4,000-volt, four-wire, grounded neutral system, which practically doubled the use of its copper at a comparatively small cost. Soon this was seen to be inadequate, and by 1917 the company was faced with the problem of determining a permanent policy for handling its power business. An investigation showed that a 23,000-volt system would yield maximum economy for Fall River conditions. The potential load in the city totaled 100,000 kw., and at present the company supplies about 40 per cent of this. The 23,000-volt system was approved and a comprehensive plan of development inaugurated with the objective of furnishing reliable service to widely scattered mills through a feeder loop system embodying flexibility of arrangement and first-class relaying. A construction program closely co-ordinated the addition of various power customers to the groups already supplied with energy.

The importance of maintaining continuous power service to the groups of great textile establishments has been recognized by the company's engineers and executives from the outset. Aside from the economies of central-station service from the standpoint of the textile mill, provision for regularity of supply is of prime importance and perhaps the controlling factor in the decision to purchase power and concentrate mill management upon production and distribution problems. As the accom-

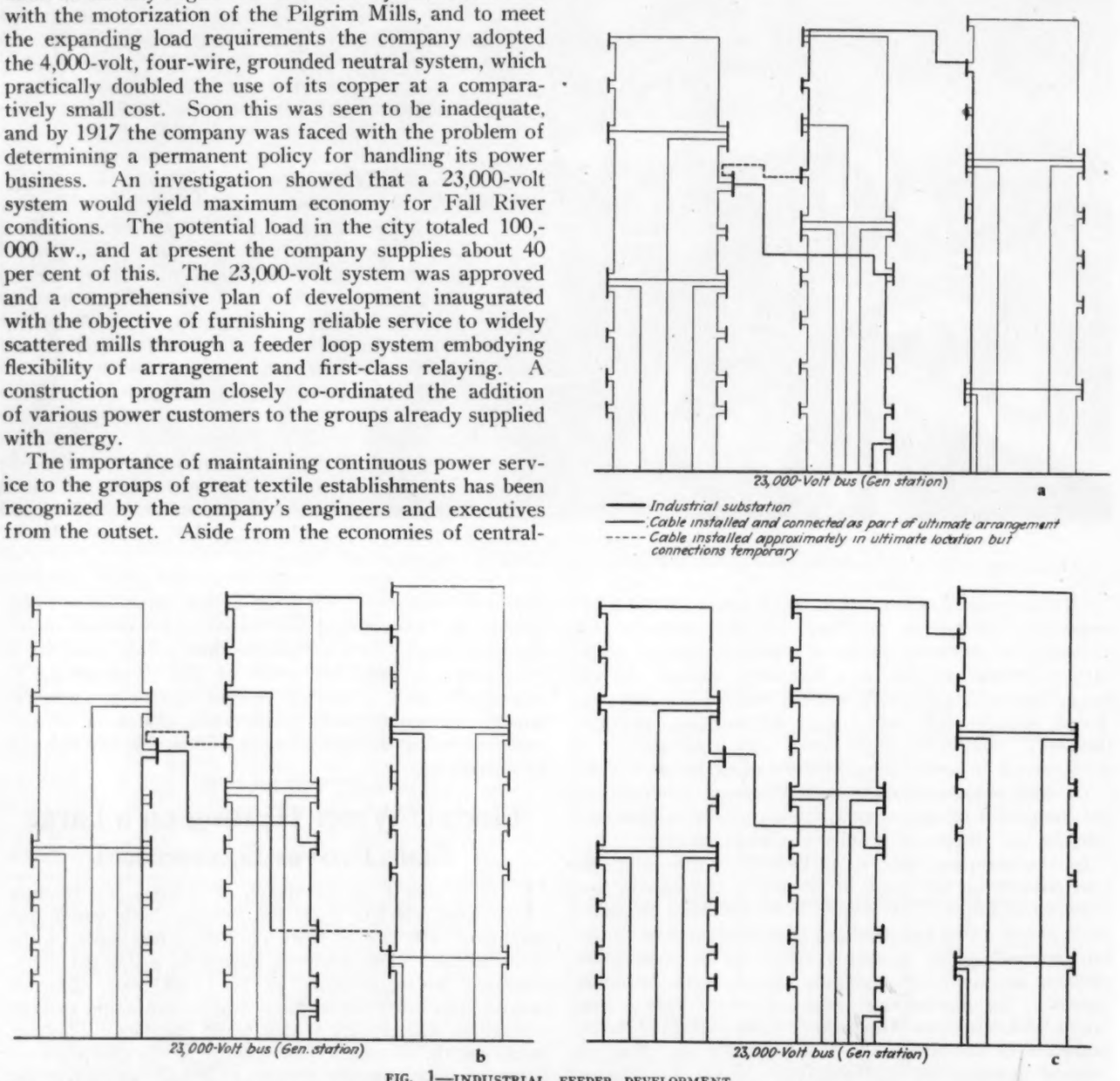


FIG. 1—INDUSTRIAL FEEDER DEVELOPMENT

The progressive steps in providing service according to a definite plan to insure a minimum of interruptions to customer's supply is shown from (*a*) the initial conditions, (*b*) present arrangement to (*c*) the ultimate loop circuits.

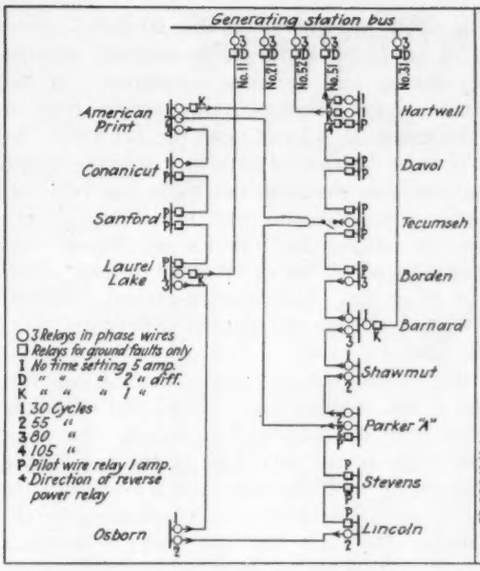


FIG. 2—GENERAL SCHEME OF RELAY PROTECTION, PRESENT DEVELOPMENT

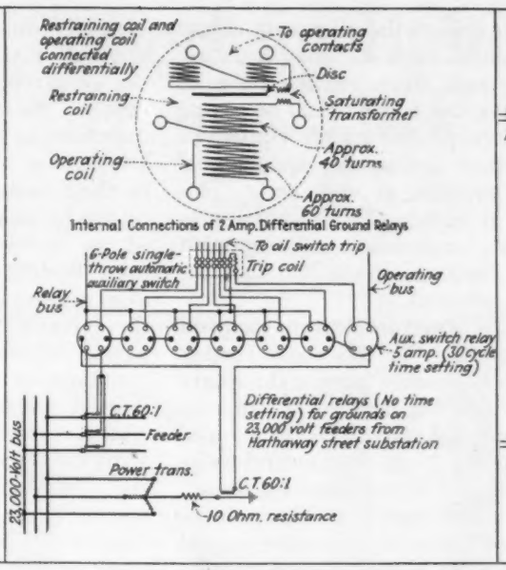


FIG. 3—WIRING DIAGRAM, DIFFERENTIAL GROUND RELAYS

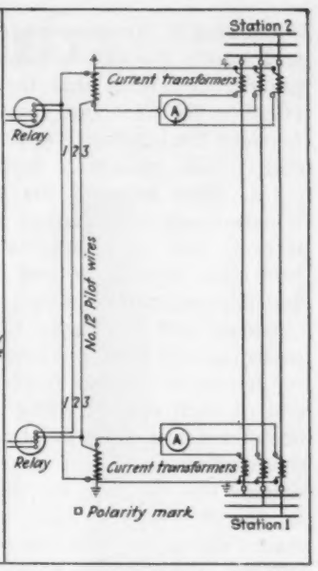


FIG. 4—COLE PILOT-WIRE RELAY ARRANGEMENT

panying diagrams show, the Fall River company has laid out this feeder system with unusual care in reference to alternative means of serving individual mills in case of trouble at local points.

The initial, present and ultimate schemes of feeder layout are shown in the corresponding illustration. The company has standardized on three-phase, 250,000-circ.mil cables, each having a rating of 90,000 kva. Transformers are connected delta-delta, the system neutral being grounded at the source end only. Ultimately there will be four and possibly five separate loops, each fed by four or five cables. As stated, the load has grown at relatively widely separated points and from time to time the company has installed duct and cable to fit the ultimate loop arrangement, but during the interim, while the system is growing, all cables have been tied into a single network.

In the diagrams, the heavy full lines show the buses of industrial substations on the system as customers at the period of each drawing and also the cables installed and connected as a part of the ultimate development. The lighter full lines show the ultimate development (except of course in the diagram of the completed system, where all feeder lines are of the same weight), both in feeders and in the buses of future substations which it is expected will be receiving purchased power from the company. Temporary connections are shown in dotted lines.

It will be seen that from the start each industrial substation bus has had the benefit of at least two sources of supply. In the present layout some of the industrial substations are provided with three incoming lines, either forming part of a loop or furnishing direct service from the main station bus, and there are a number of substations fed by two lines, with a third feeder to a near-by portion of the loop which can be called upon in need. This application of supplementary feeders to important centers of distribution has been carried to a high pitch of efficiency in the ultimate layout, with tie lines between important geographical groups over which loads may be dispatched with maximum convenience under a wide range of operating conditions.

Through the courtesy of H. A. Stanley, superintendent of the company, the following particulars are given of the relaying scheme adopted in connection with this system of industrial power supply. The fundamental protective feature provides that as far as possible all failures, and particularly cable failures, will be to ground rather than between phases. This is accomplished by the use of the Hochstadter type of cable. The second fundamental involves grounding the system neutral through a resistance which in this case is 10 ohms, thus limiting the flow of energy in a ground fault to about 17,400 kva. (the product of 13,200 volts by 1,320 amp., single phase). It is not contended that this ideal has been attained, but progress is being made in this direction.

Referring to the diagram of relay set-ups for the present cable installation, the basic protection is obtained through directional relays with timing elements in decreasing sequence in each direction around the main ring, the longest time delay being nearest the source end. The company's experience indicates that an over-all difference of 25 cycles between substations is about the minimum desirable for continued reliability. This method of relaying gives full reliability for a small number of substations in series. It has the defect that each new substation added to the system increases the total tripping time at the source end. A total tripping time of more than two seconds is usually regarded as excessive in a cable system, so that, unless supplemented by other relays, the company would be limited to four or five substations in series.

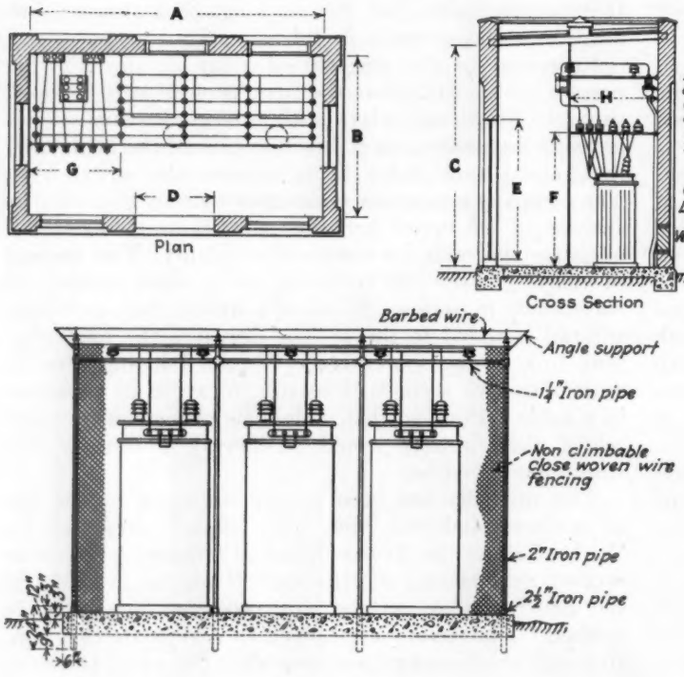
This difficulty has been largely overcome by the use of a three-conductor pilot wire scheme suggested by W. H. Cole of the Boston Edison Company. The cable sections terminating at the letter *P* on the drawing of the general relay scheme are protected by the Cole method. The details are shown in a separate diagram. Current transformers are provided for each phase at both ends of the cable section. The transformers are short circuited to one another at each end through an additional 1 to 1 current transformer. The secondaries of the 1 to 1 current transformers are so connected through two of the pilot wires that a through short circuit in the cable will induce additive currents in the pilot wire circuit. The third pilot wire is connected across

equipotential points at each end of the pilot wire circuit and passes through a relay in each station. It is apparent, therefore, that through short circuits have no effect on the pilot wire relays, but a cable fault occurring between the pilot wire stations produces a reversal at one end. This induces a voltage across the equipotential points, thus tripping the switches at each end. This scheme could be expanded to include phase-to-phase protection, but the company's experience indicates that protection against ground faults is ample and that the added complication is unwarranted.

Experience has shown that speed in clearing incipient cable failures is highly desirable. To this end a further refinement in relaying has been worked out for the source end of each cable feeding into the network which may be defined as a differential ground relay. The location of these relays is shown at point *D* on the general relay scheme diagram and the detailed connections are shown in the drawing of relay circuit details. This scheme makes use of the principle of balancing the entire neutral current of the system against the neutral current flowing in a faulty feeder. One relay of the induction type is required for each feeder. The total current flowing in the system neutral is utilized to actuate a restraining coil in all of the relays in series. The neutral current in each feeder is passed through the operating coil of the relay corresponding to the particular feeder. The turn ratio is so chosen that the relays operate positively on faults within one mile from the station and with reasonable certainty on a fault anywhere on the so-called direct feeders—that is, on faults in the cable sections between the generating station and the first substation. In the case of the two longer feeders, relay action may be uncertain in the event of a fault near the far end. No known way has been discovered to insure positive action in these cases, and the lesser of two evils has been accepted by inserting an additional relay in the trip circuits of the differential relays, the function of which is to open the trip circuits of all the differential ground relays after a lapse of 30 cycles. This insures correct action of the substation relays by sacrificing the differential protection in these doubtful cases.

Offsetting the basic transmission economies of this type of system is the obvious fact that all the ring substation switches may be subjected to nearly the same short-circuit stresses as the switches at the generating end. With increasing synchronous capacity feeding the system, it has become apparent that safe operation of the ring circuit breakers requires that the relays controlling them be confined to operation on ground faults only. Even with the metal-foil type of cable, simultaneous grounds can occur on the different phases. Experience indicates, however, that phase-to-phase faults, or double grounds, are sufficiently infrequent, so that adequate service is assured for the present by providing full-sized breakers at two strategic points in the system. These breakers operate only on simultaneous fault current in two phases.

Standardization of Customers' Substations

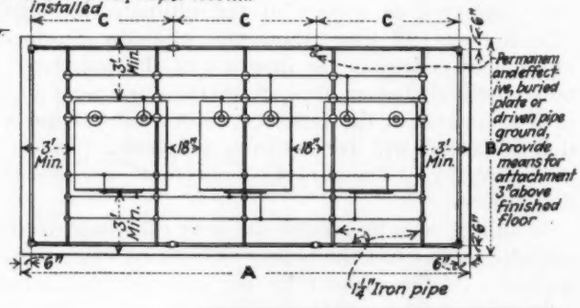


Recommended oil basin and sewer connection capacity, when installed, equal to or greater than oil capacity of largest transformer unit

Louvres and Ventilators Capacity recommended
Louvres-min. 6 sq.ft. per 1000 kw. installed
Ventilators-min. 4 sq. ft. per 1000 kw. installed

DIMENSIONS OF TYPICAL 3 UNIT CONSUMER'S SUBSTATION

DIMENSION	CAPACITY OF TRANSFORMERS 100 KVA. 150 " 200 "	250 KVA. 333 "	400 KVA. 500 "	667 KVA. 833 "	1000 KVA.	1250 KVA.
A	21'-0"	22'-0"	24'-0"	28'-0"	30'-0"	36'-0"
B	11'-0"	12'-0"	13'-0"	14'-0"	16'-0"	17'-0"
C	15'-9"	16'-9"	18'-4"	18'-4"	19'-0"	19'-0"
D	6'-0"	6'-0"	6'-0"	7'-0"	8'-0"	8'-0"
E	10'-0"	11'-0"	13'-0"	13'-0"	14'-0"	14'-0"
F	9'-8"	11'-0"	12'-8"	12'-8"	13'-4"	13'-4"
G	8'-3"	8'-3"	8'-3"	8'-3"	8'-3"	8'-3"
H	7'-0"	7'-0"	7'-0"	7'-0"	7'-0"	7'-0"

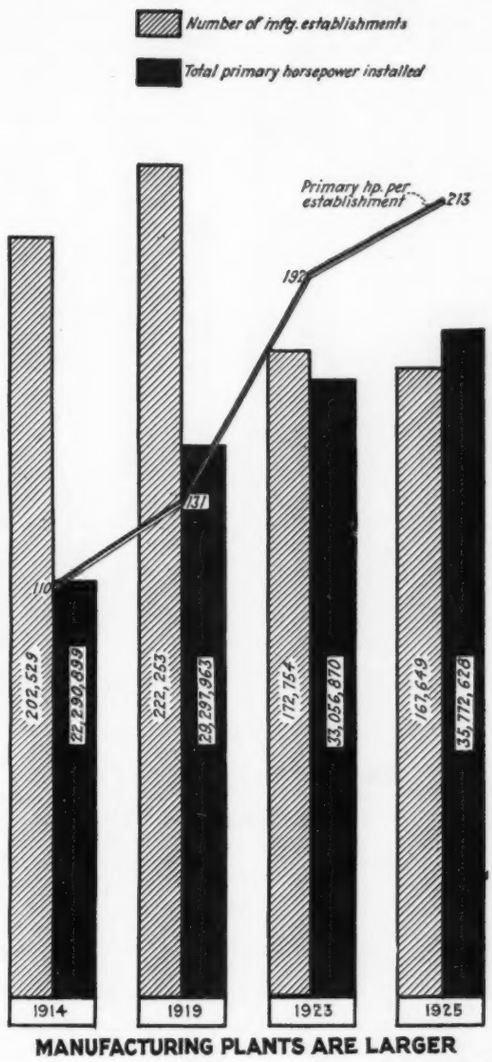


DIMENSIONS OF TYPICAL 3 UNIT OUTDOOR SUBSTATION

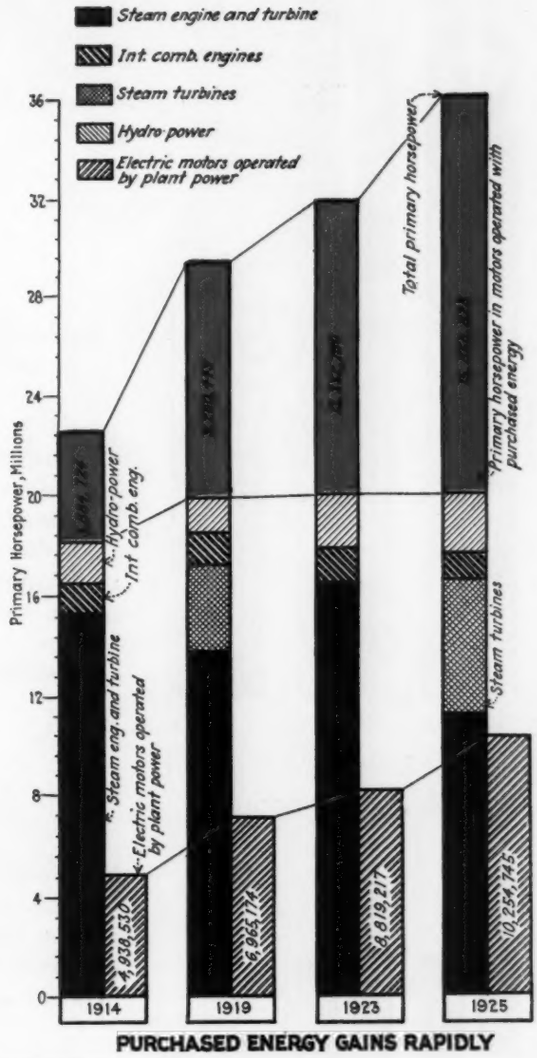
DIMENSION	CAPACITY OF TRANSFORMERS 100 KVA. 150 " 200 "	250 KVA. 333 "	400 KVA. 500 "	667 KVA. 833 "	1000 KVA.	1250 KVA.
A	21'-10½"	20'-0"	22'-0"	26'-6"	28'-0"	35'-0"
B	9'-8"	10'-1"	10'-5"	10'-8"	11'-3"	11'-4"
C	6'-11½"	6'-4"	7'-3"	8'-6"	9'-3"	11'-4"

A BASIC design for indoor and outdoor substations for industrial customers which may be altered for specific requirements has been developed by the Connecticut Light & Power Company, of Waterbury. The indoor and outdoor structures have been arranged for individual transformer capacities from 100 to 1,250 kva. at a primary voltage of 13,800. Three units are provided in each station, giving a maximum capacity of 3,750 kva. Standardization of the general design does not permit modification of details and simplifies quick service.

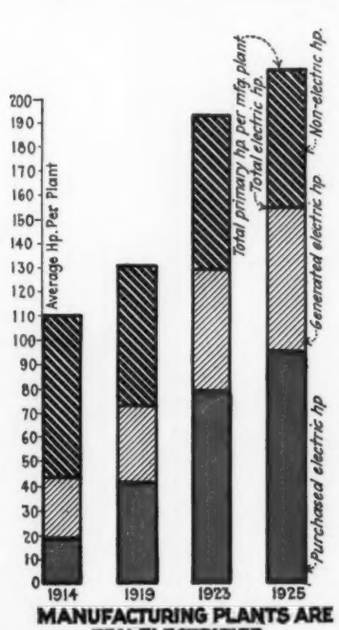
Power in American Industry



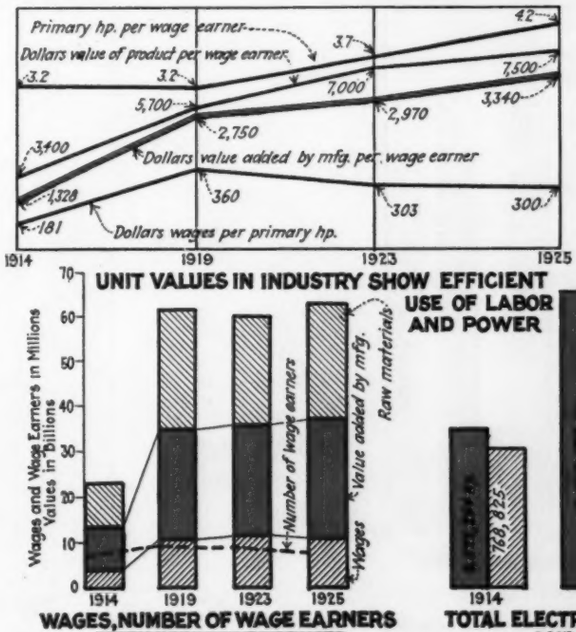
MANUFACTURING PLANTS ARE LARGER



PURCHASED ENERGY GAINS RAPIDLY

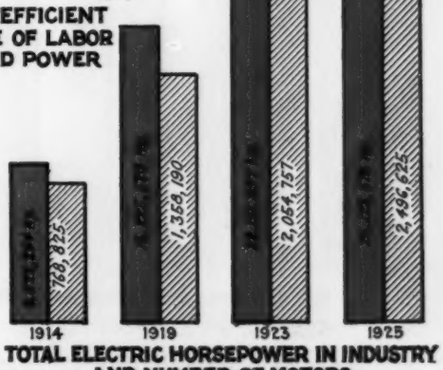


MANUFACTURING PLANTS ARE 75% ELECTRIFIED



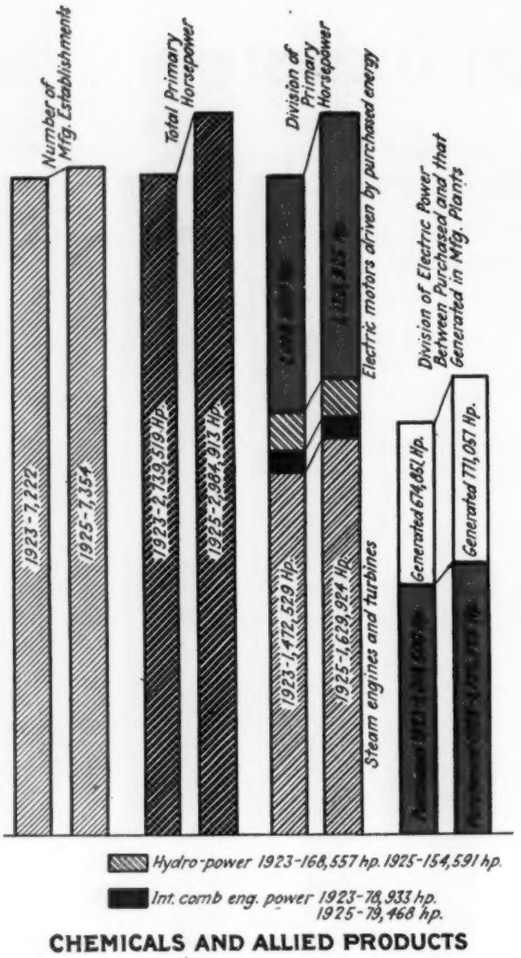
UNIT VALUES IN INDUSTRY SHOW EFFICIENT USE OF LABOR AND POWER

WAGES, NUMBER OF WAGE EARNERS AND VALUE OF PRODUCTS



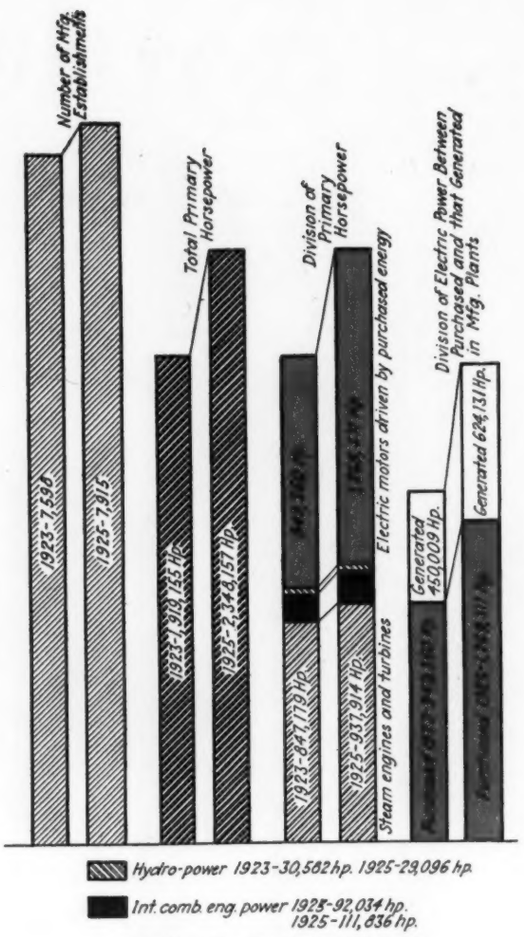
TOTAL ELECTRIC HORSEPOWER IN INDUSTRY AND NUMBER OF MOTORS

The chemical industries offer an electrical market of 1,100,000 hp.



CHEMICALS AND ALLIED PRODUCTS

Electric power predominates in the production of stone, clay and glass products

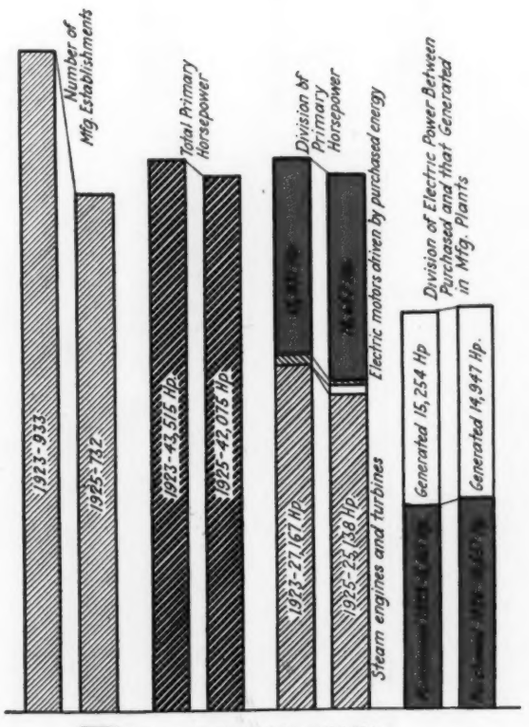


STONE, CLAY AND GLASS

Non-ferrous industries show little growth in power use

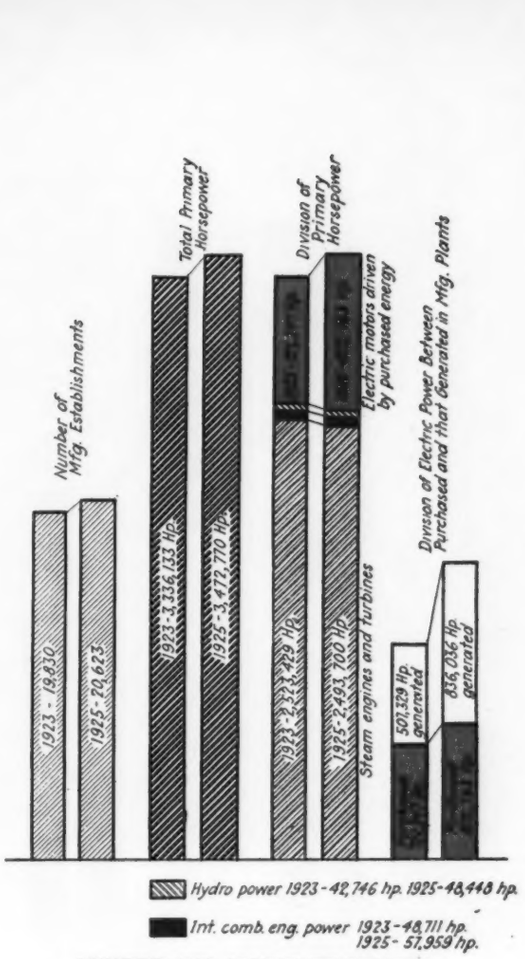
METALS AND METAL PRODUCTS OTHER THAN IRON AND STEEL

Tobacco industries have not been sold power



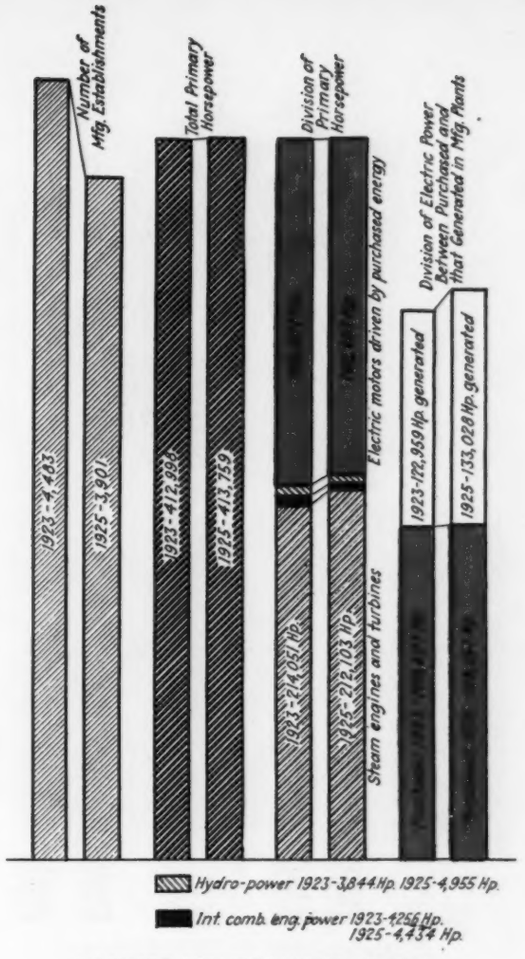
TOBACCO MANUFACTURES

Electrification of the lumber industry is yet to be accomplished. It needs modernization


Number of Mfg. Establishments
1923 - 19,830
1925 - 20,623
Total Primary Horsepower
1923 - 3,336,133 Hp.
1925 - 3,472,770 Hp.
Division of Primary Horsepower
1923 - 2,323,429 Hp.
1925 - 2,493,700 Hp.
Electric motors driven by purchased energy
Steam engines and turbines
Division of Electric Power Between Purchased and that Generated in Mfg. Plants
501,329 Hp. generated
836,036 Hp. generated
Hydro power 1923 - 42,746 hp. 1925 - 48,448 hp.
Int. comb. eng. power 1923 - 48,711 hp. 1925 - 57,959 hp.

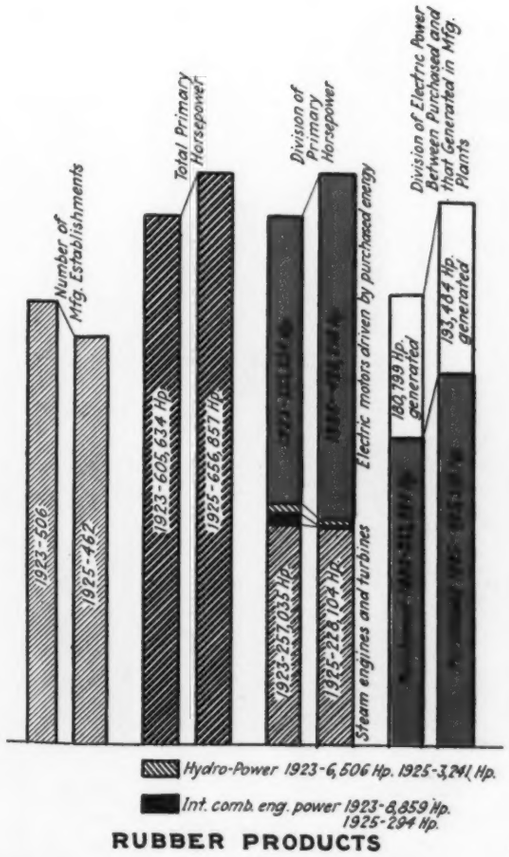
LUMBER AND ALLIED PRODUCTS

The leather industry offers a good electrification market for utilities and electrical manufacturers


Number of Mfg. Establishments
1923 - 4,183
1925 - 3,901
Total Primary Horsepower
1923 - 412,284
1925 - 413,759
Division of Primary Horsepower
1923 - 21,405 Hp.
1925 - 212,703 Hp.
Electric motors driven by purchased energy
Steam engines and turbines
Division of Electric Power Between Purchased and that Generated in Mfg. Plants
1923 - 179,959 Hp. generated
1925 - 133,028 Hp. generated
Hydro-power 1923 - 3,844 Hp. 1925 - 4,955 Hp.
Int. comb. eng. power 1923 - 4256 Hp. 1925 - 4,434 Hp.

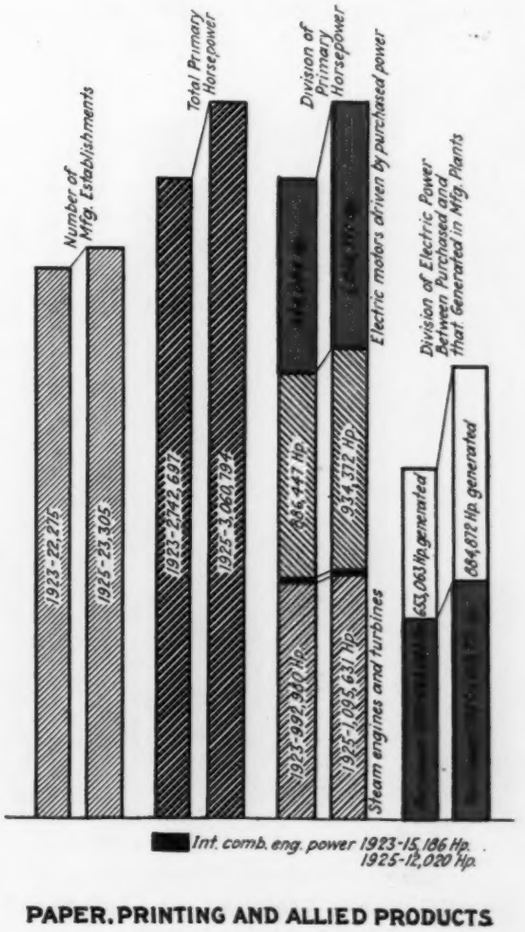
LEATHER AND ITS MANUFACTURES

The rubber industry has been alert to the advantages of electrification

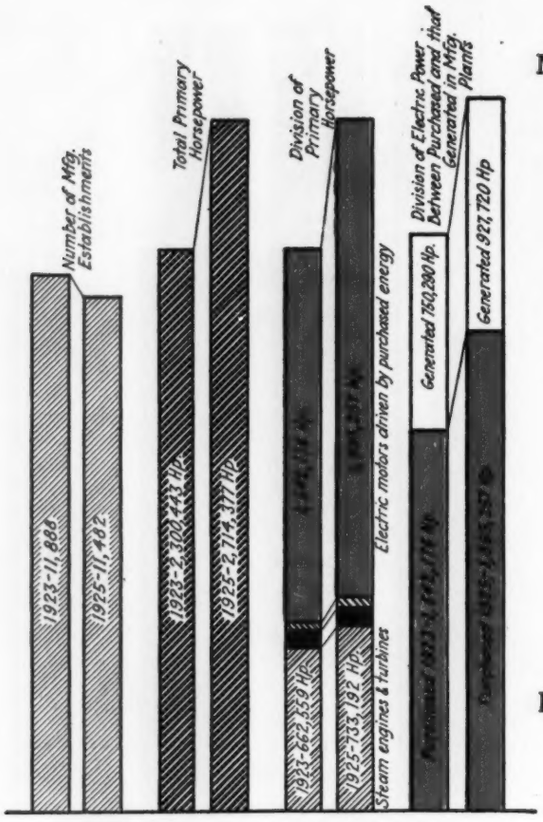

Number of Mfg. Establishments
1923 - 506
1925 - 462
Total Primary Horsepower
1923 - 605,634 Hp.
1925 - 656,657 Hp.
Division of Primary Horsepower
1923 - 257,035 Hp.
1925 - 228,104 Hp.
Electric motors driven by purchased energy
Steam engines and turbines
Division of Electric Power Between Purchased and that Generated in Mfg. Plants
180,739 Hp. generated
193,454 Hp. generated
Hydro-Power 1923 - 6,506 Hp. 1925 - 3,241 Hp.
Int. comb. eng. power 1923 - 8,859 Hp. 1925 - 294 Hp.

RUBBER PRODUCTS

Despite the improvements in electric drives, the paper industry retains old and wasteful methods


Number of Mfg. Establishments
1923 - 22,215
1925 - 23,705
Total Primary Horsepower
1923 - 2,772,691
1925 - 3,044,794
Division of Primary Horsepower
1923 - 932,240 Hp.
1925 - 1,095,631 Hp.
Electric motors driven by purchased power
Steam engines and turbines
Division of Electric Power Between Purchased and that Generated in Mfg. Plants
653,063 Hp. generated
884,672 Hp. generated
Int. comb. eng. power 1923 - 15,186 Hp. 1925 - 12,020 Hp.

PAPER, PRINTING AND ALLIED PRODUCTS

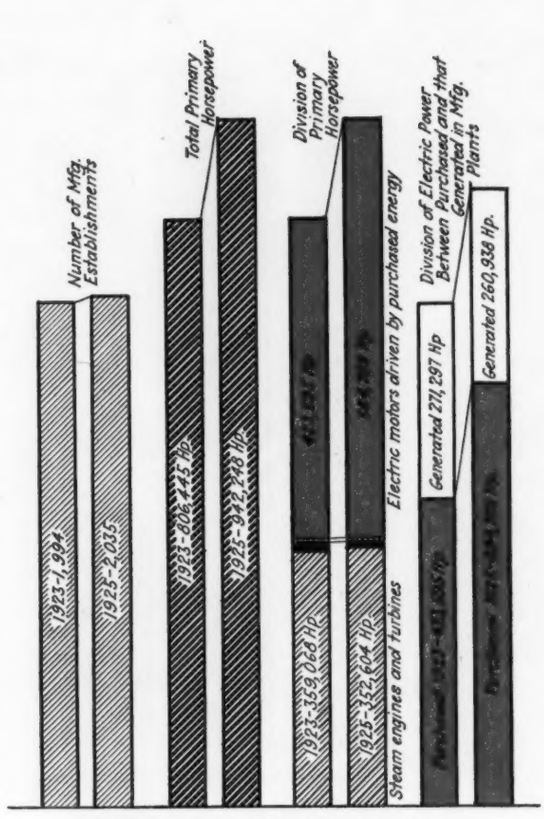


Manufacturers of machinery study economic production and use electric power to get results

Hydro-power 1923-26,522 hp. 1925-22,166 hp.

Int. comb. eng. power 1923-68,186 Hp. 1925-63,762 hp.

MACHINERY NOT INCLUDING TRANSPORTATION EQUIPMENT



Electric drives predominate in railroad repair shops

Hydro-power 1923-88 hp. 1925-32 hp.

Int. comb. eng. power 1923-23,684 hp. 1925-4,823 hp.

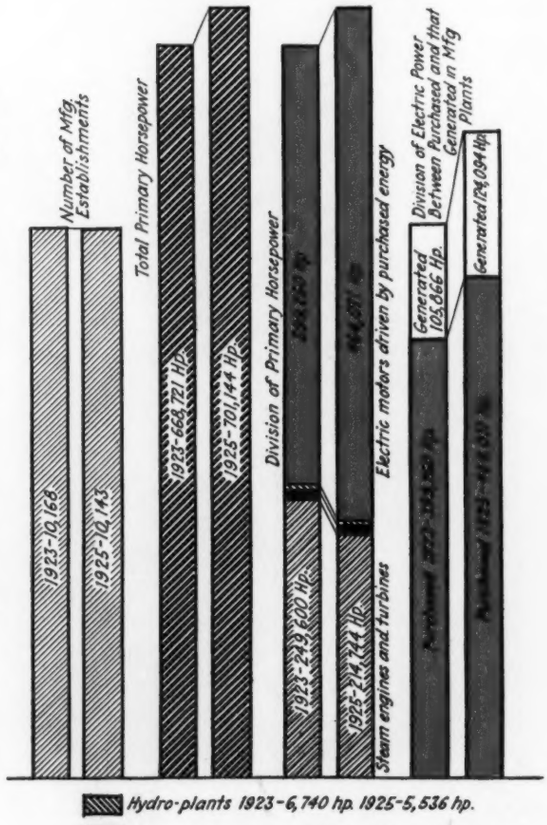
RAILROAD REPAIR SHOPS

Light and power companies have done a good selling job in the transportation equipment industry

Hydro-plants 1923-10,940 hp. 1925-1,487 hp.

Int. comb. eng. power 1923-50,490 hp. 1925-16,766 hp.

TRANSPORTATION EQUIPMENT, AIR, LAND, WATER

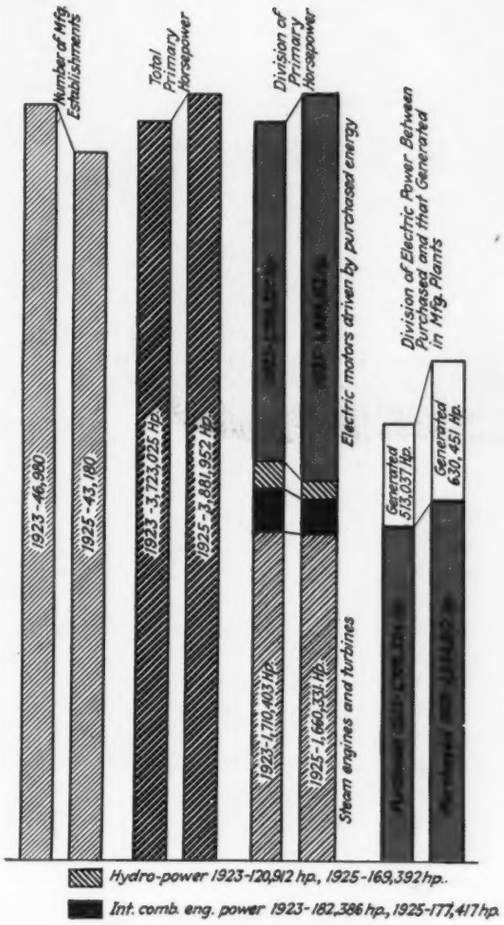


Purchased power predominates in miscellaneous small manufacturing plants

Hydro-plants 1923-6,740 hp. 1925-5,536 hp.

Int. comb. eng. power 1923-13,111 hp. 1925-17,783 hp.

OTHER INDUSTRIES

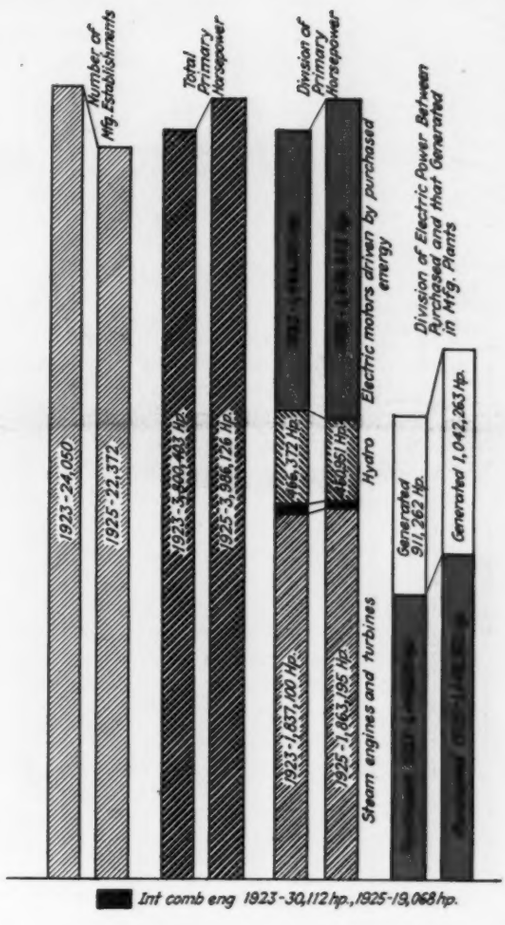

Number of Mfg. Establishments
Total Primary Horsepower
Division of Primary Horsepower
Division of Electric Power Between Purchased and that Generated in Mfg. Plants
1923 - 46,980
1925 - 43,180
1923 - 3,723,025 Hp.
1925 - 3,881,952 Hp.
1923 - 1,710,403 Hp.
1925 - 1,660,331 Hp.
Electric motors driven by purchased energy
Steam engines and turbines
Generated 513,031 Hp.
Generated 630,451 Hp.
Hydro-power 1923-120,912 hp., 1925-169,392 hp.
Int. comb. eng. power 1923-182,386 hp., 1925-177,417 hp.

FOOD AND KINDRED PRODUCTS

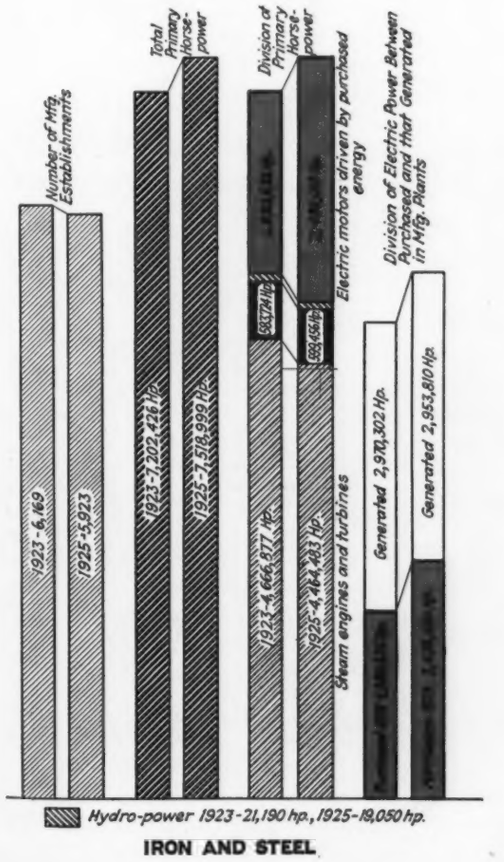
Food product industries offer an electric power load of 2,000,000 hp.

Textile industries are growing and offer a 2,300,000 hp. electric power market

There remains a 5,000,000 hp. power market in the iron and steel industry


Number of Mfg. Establishments
Total Primary Horsepower
Division of Primary Horsepower
Division of Electric Power Between Purchased and that Generated in Mfg. Plants
1923 - 24,050
1925 - 22,372
1923 - 3,306,726 Hp.
1925 - 3,306,726 Hp.
1923 - 1,837,100 Hp.
1925 - 1,863,195 Hp.
Electric motors driven by purchased energy
Steam engines and turbines
Hydro
Generated 911,262 Hp.
Generated 1,042,263 Hp.
Int comb eng 1923 - 30,112 hp., 1925 - 19,068 hp.

TEXTILES AND THEIR PRODUCTS


Number of Mfg. Establishments
Total Primary Horse-power
Division of Primary Horse-power
Division of Electric Power Between Purchased and that Generated in Mfg. Plants
1923 - 6,169
1925 - 5,923
1923 - 1,202,426 Hp.
1925 - 1,519,999 Hp.
1923 - 4,666,877 Hp.
1925 - 4,464,283 Hp.
Electric motors driven by purchased energy
Steam engines and turbines
Generated 2,911,302 Hp.
Generated 2,953,810 Hp.
Hydro-power 1923-21,190 hp., 1925-19,050 hp.

IRON AND STEEL

The Job is Not Half Finished

AMERICAN industry is reputed to be successful because it uses larger amounts of power per worker. Another element in the situation is the kind of power used, for the readily available, easily controlled, flexible electric power adapts itself splendidly to production processes.

Electrical men have done a good selling job but the evidence exhibited in the accompanying graphs shows that the market has been only half saturated. It controverts the often made statement that industry is a saturated electric power market. A study of the data shows that electric power increase is only at a rate corresponding to industry growth and that a market exists for over 10,000,000 electric horsepower. Add to this the electric heating load possibilities and there is offered a market that should spur all electrical men to renewed sales efforts.

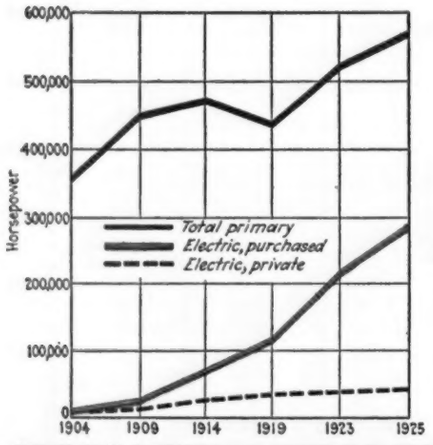
A study of the industries by separate graphs shows that some have been relatively neglected by proponents of electrification. In general, new industries have adopted electric power and old industries have retained other forms of power and traditional production methods. It will pay every manufacturer and every utility to study the classified industry power data as given in the U. S. Census of manufacturers. A definite market analysis is available for application to business. Once markets are visualized sales opportunities may be grasped and selfish as well as national interest will be satisfied by a more rapid and more intelligent electrification of American industry.

Detailed Electrical Market Data Available

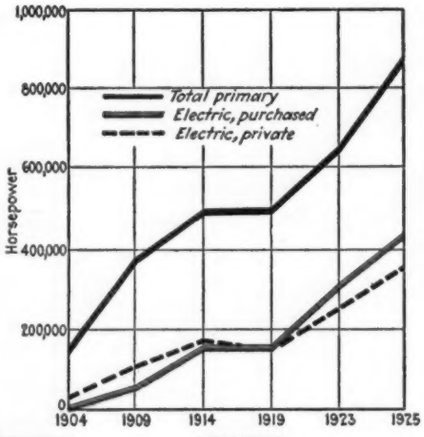
THE U. S. census of manufacturers gives data on American industry of great value to electrical men. More than two hundred industries are represented in tabulations which show the power, the prime movers, the purchased energy and the generated energy used in these industries. The following curves are representative of these data as complied over a period of years and show typical trends and definite power data for representative industry.

Striking features of these graphs are the growth of total power used since 1904 and the general trend toward a greater use of electric power. But from an electrical market standpoint there are remarkable differences in the use of electric power in the several industries. The automobile industry, for example, is electrified but the cotton goods industry is not half electrified. Also, the same differences are found in the proportions of total power purchased from light and power utilities in different industries. These differences cannot be explained entirely by use of process steam or other standard alibis to selling slackness. The evidence is overwhelming that the electrical industry has not studied its markets sufficiently and has not conducted its sales according to market studies.

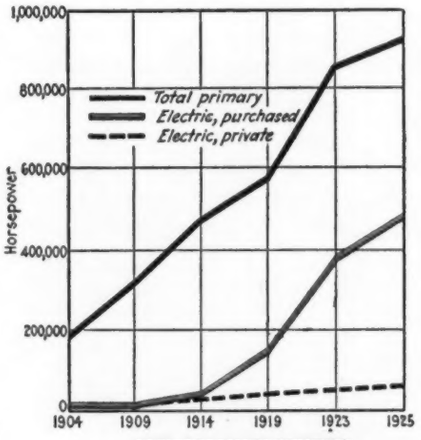
It is gratifying to find such wonderful markets for electrification in industry, and the present conditions are conducive to a more intelligent exploitation of these markets. Sales opportunities now exist and industry grows at such a rate that electrification developments may proceed apace for many years without fear of saturated markets.



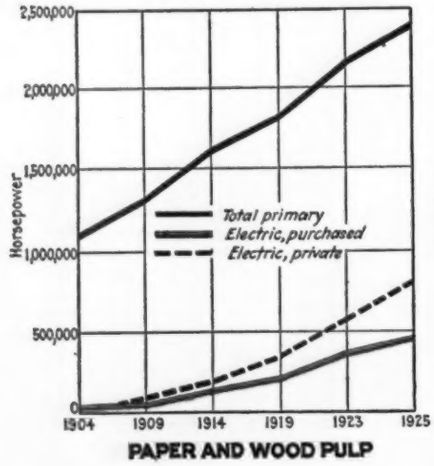
BRICK, TILE, POTTERY AND OTHER CLAY PRODUCTS



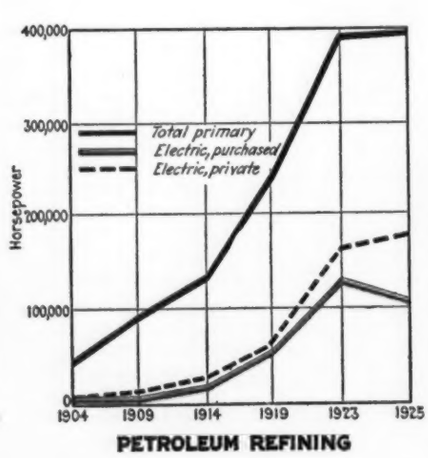
CEMENT



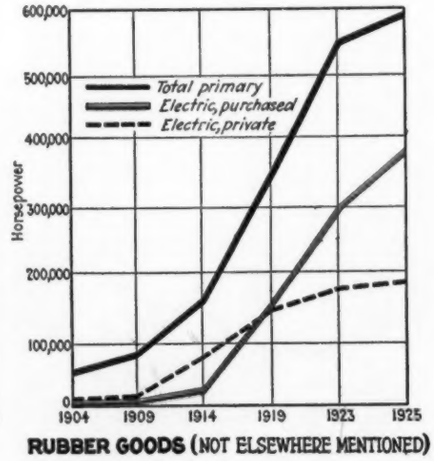
ICE-MANUFACTURED



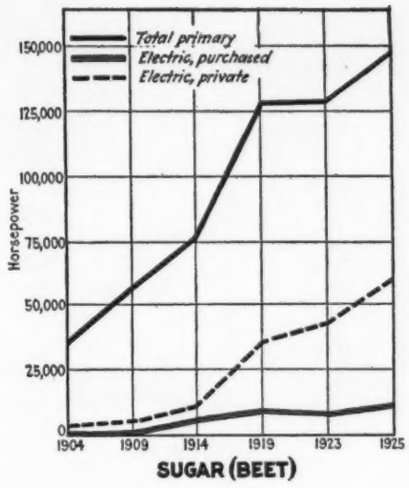
PAPER AND WOOD PULP



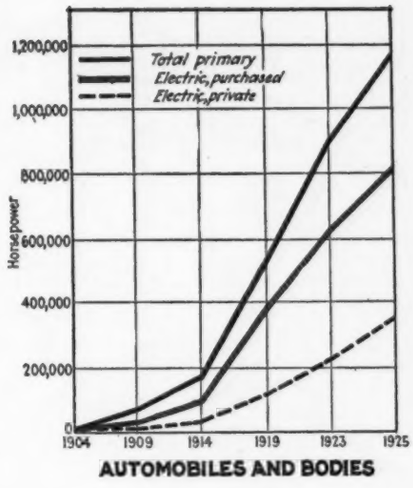
PETROLEUM REFINING



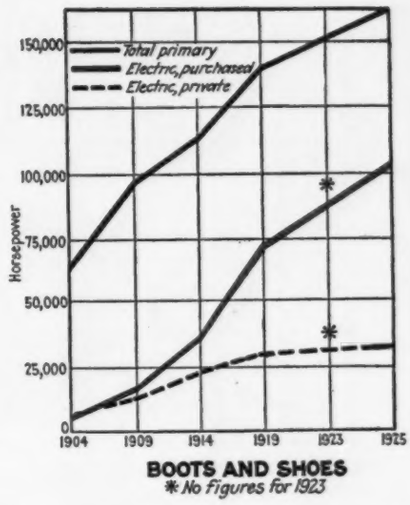
RUBBER GOODS (NOT ELSEWHERE MENTIONED)



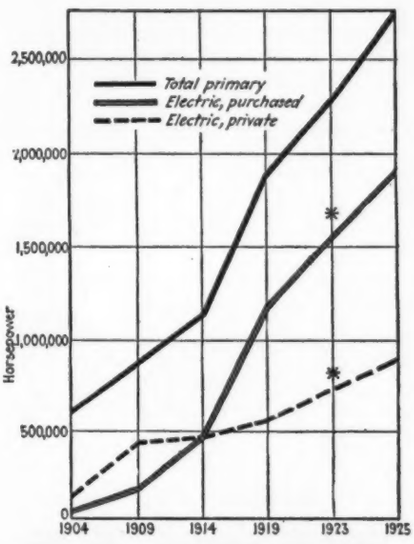
SUGAR (BEET)



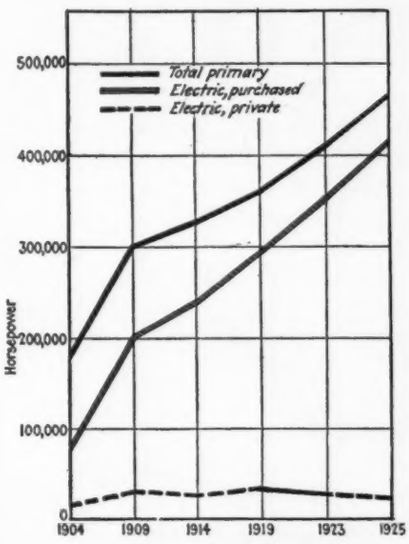
AUTOMOBILES AND BODIES



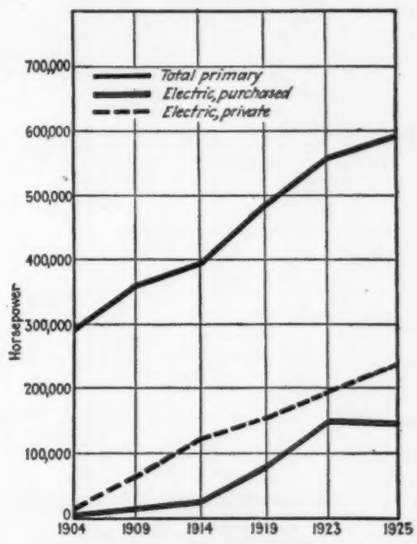
BOOTS AND SHOES
* No figures for 1923



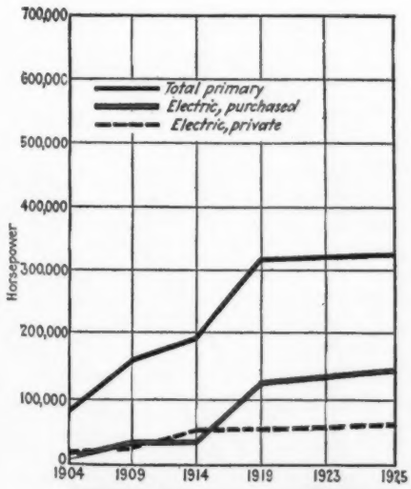
FOUNDRY AND MACHINE SHOP PRODUCTS
* No figures for 1923



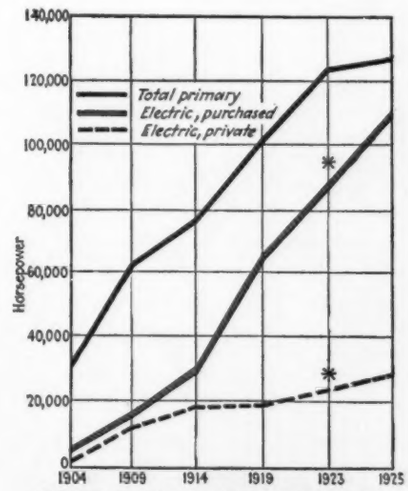
PRINTING AND PUBLISHING



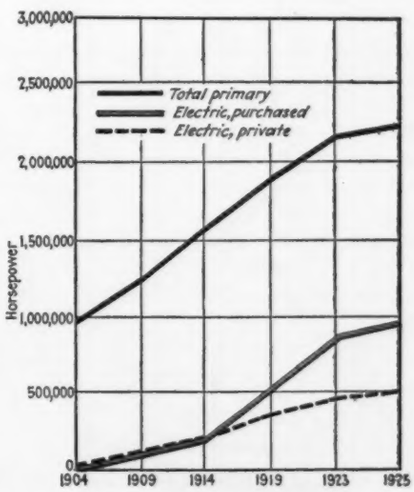
WOOLEN, WORSTED AND FELT GOODS AND WOOL HATS



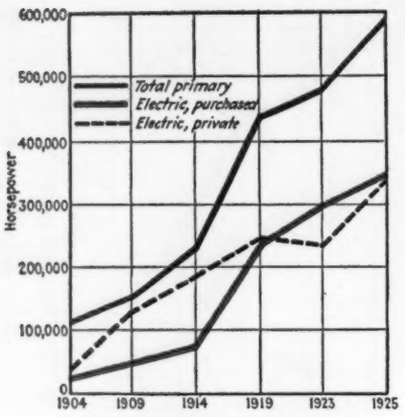
COPPER SMELTING AND REFINING



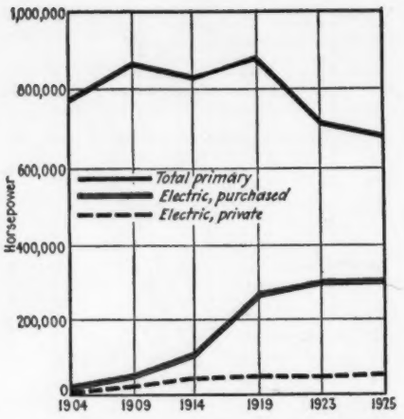
COPPER, TIN AND SHEET IRON PRODUCTS
* No figures for 1923



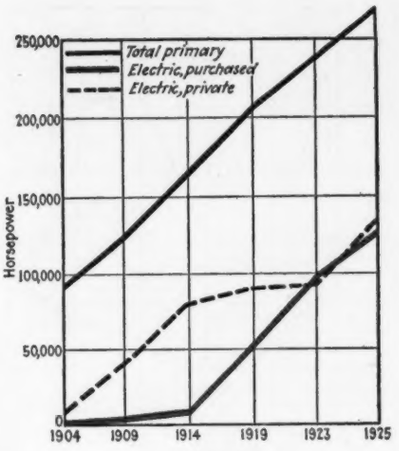
COTTON GOODS



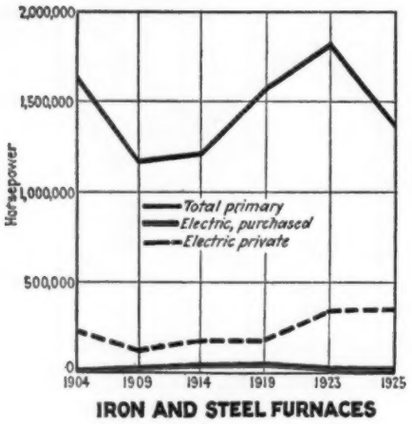
ELECTRICAL MACHINERY



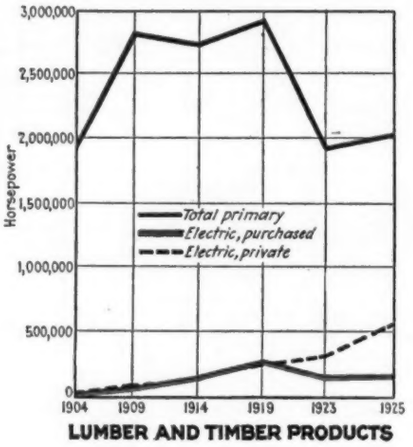
FLOUR-MILL AND GRIST MILL PRODUCTS



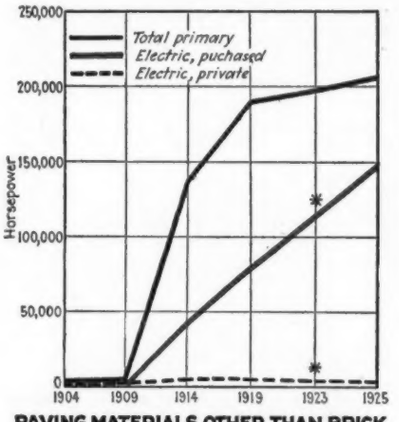
GLASS



IRON AND STEEL FURNACES

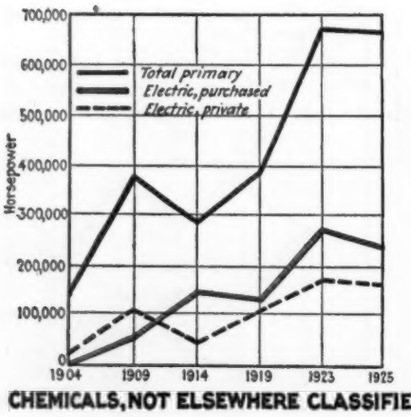


LUMBER AND TIMBER PRODUCTS

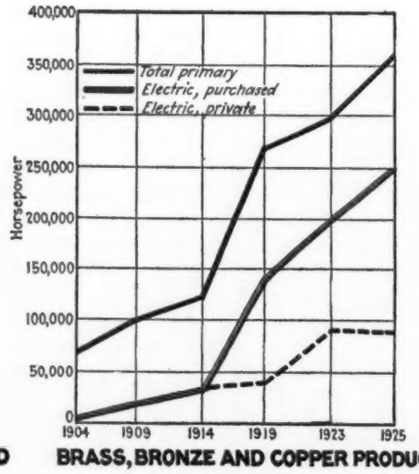


PAVING MATERIALS, OTHER THAN BRICK

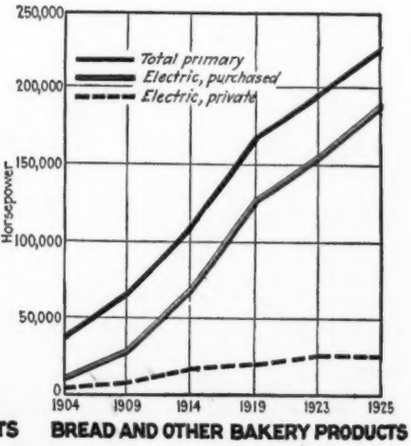
* No Figures for 1923



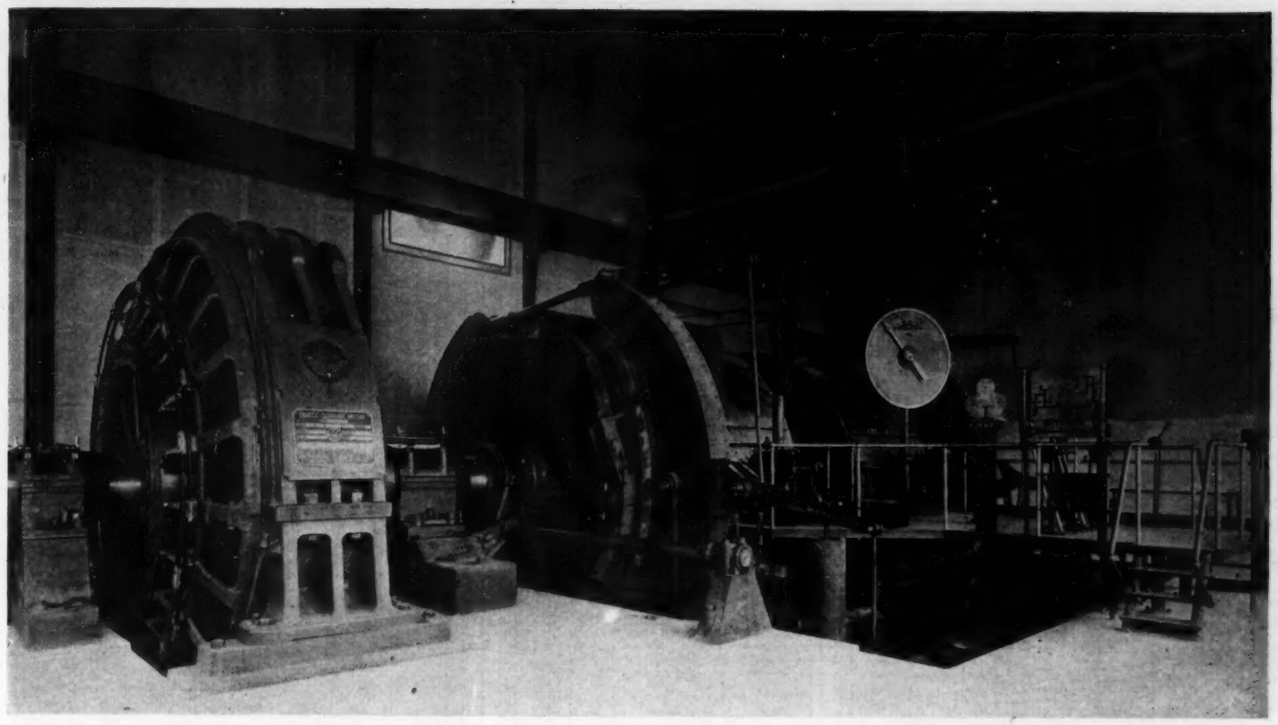
CHEMICALS, NOT ELSEWHERE CLASSIFIED



BRASS, BRONZE AND COPPER PRODUCTS



BREAD AND OTHER BAKERY PRODUCTS



This electrically driven hoist at the Belmont mine operates for one-fifth the cost of replaced equipment.

Electrical Practice in Copper Mining

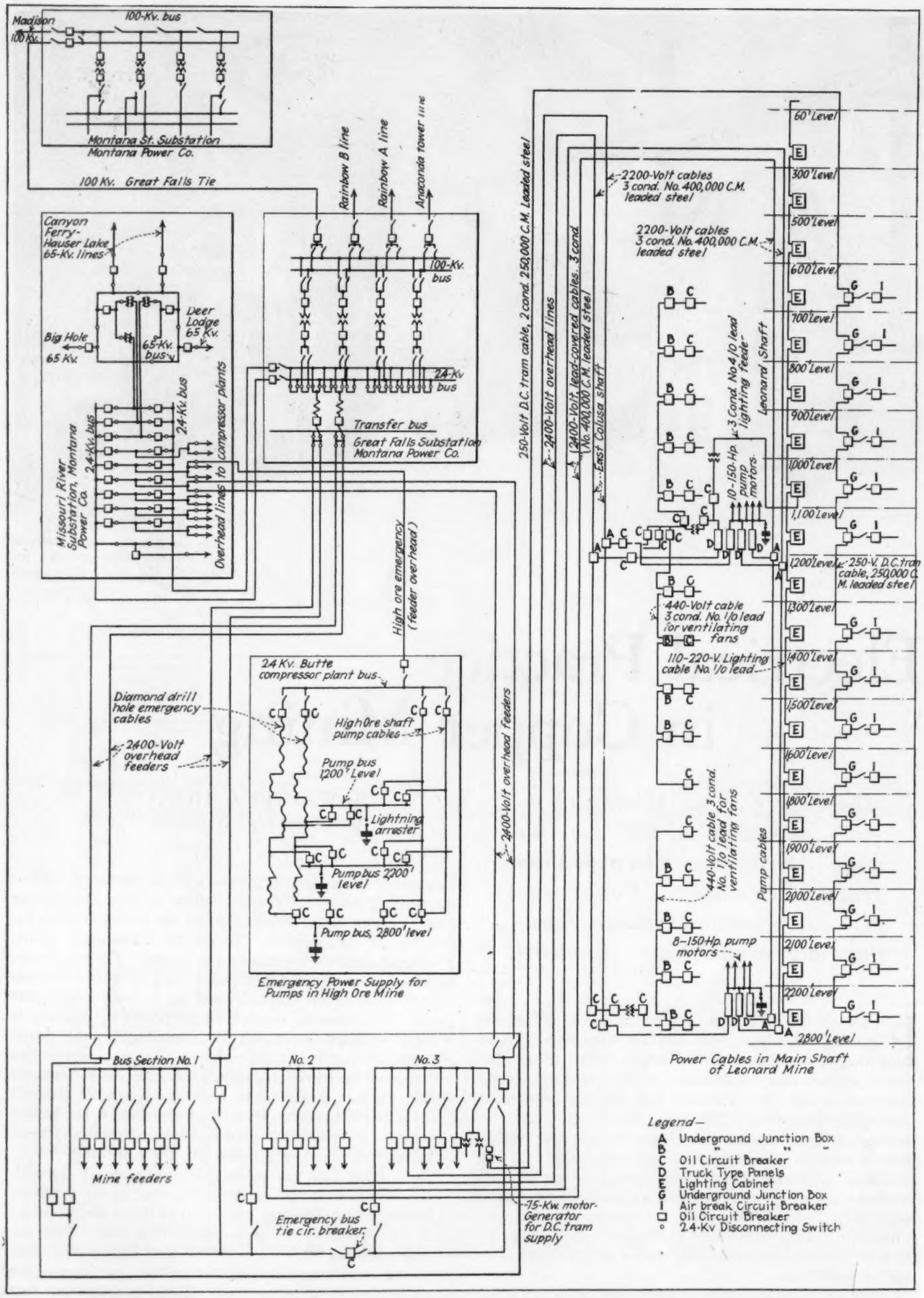
Anaconda Copper Mining Company purchases 27,000 kw. for mine operation. Electrification practically complete. Power supply, construction, haulage, hoisting and signals are discussed

By WALTER C. HESTON
Pacific Coast Editor ELECTRICAL WORLD

ECONOMY of electric power in the underground mining of copper ore by the Anaconda Copper Mining Company, with mines at Butte, Mont., has been so marked that the 28 mines of this company, with a connected motor load of 65,470 hp., are now practically completely electrified. The only steam equipment remaining on the property is two ore hoists, and one of these is now in the process of electrification. Of the remaining 26 hoists, twenty are driven by air engines supplied with air by motor-driven air compressors. Five hoists have direct electric drive, and ultimately all hoists in main producing mines will be changed over to electric drive, because of the substantial saving in operating costs over air operation.

Power for mine operation is purchased from the Montana Power Company at 2,400 volts from two substations located on the mining property. From these substations duplicate 2,400-volt feeders radiate to five compressor plants, where about 50 per cent of the power is used for driving air compressors. From the compressor plants 2,400-volt feeders are run to the mines. The maximum monthly demand of the mining load is approximately 27,000 kw., which is purchased on a horsepower-year basis. Simultaneous demand at all points of delivery is registered on an eight-element totalizing graphic wattmeter located at one of the compressor plants. From this instrument the three highest 30-minute daily demands during the month are taken and the average of these is used as the maximum demand of the month for billing purposes. No totalized record of kilowatt-hours is kept, as kilowatt-hours do not enter into the contract.

The mining load has an annual load factor of approximately 80 per cent and an average power factor in excess of 80 per cent. The only provision in the power contract covering power factor is a clause that states that the mining company shall not add load that will be detrimental to the service rendered by the utility. In practice the parties mutually agree on types of major equipment that would affect power factor. Of the mining company's



SCHEMATIC DIAGRAM SHOWING POWER SUPPLY TO BUTTE MINES OF ANACONDA COPPER MINING COMPANY

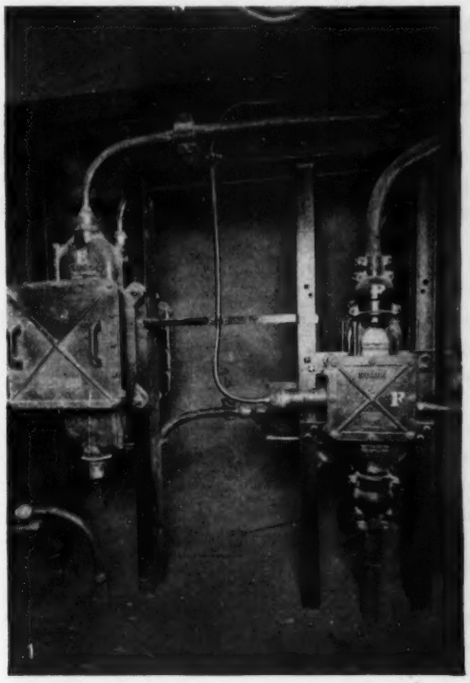
65,470-hp. connected load, 26,300 hp. is used for compressing air, of which 16,890 hp. is in synchronous motors and the remainder in induction motors. The synchronous motors are operated at 0.8 leading power factor to assist in raising the power factor of the mining load as a whole.

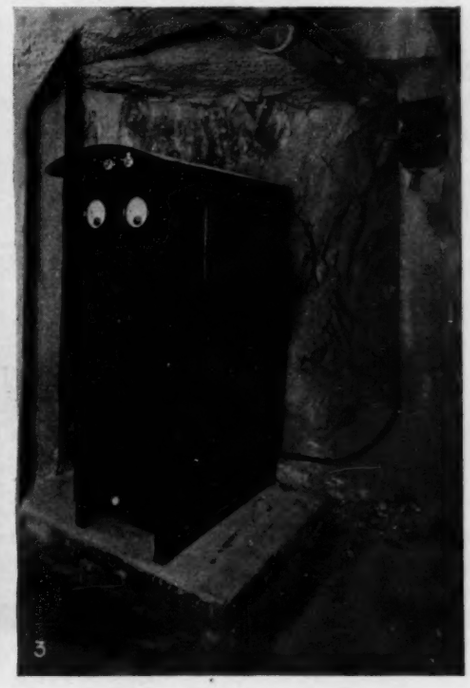
Mine Power Supply

Reliability of power supply to the mines is of vital importance, as pumps and ventilating fans must be kept in operation. In two of the mines where the principal pumping plants for all of the mines are located there are two separate and independent sources of feed. In the High Ore mine two cables go down the main shaft and two go down into the mine through diamond drill holes located some distance from the main shaft. Emergency power supply for the Leonard mine is available from two cables going down the shaft of the East Colusa mine, about 1,500 ft. from the main shaft of the Leonard mine. In the High Ore and Leonard mines there are cross-ties between the two sets of cables on two or more levels, as indicated in the accompanying single-line diagram, hence power from either set of cables is available. Normally the emergency feeders are not tied in on the underground pumping plant buses, but are energized so that they may be switched in on a moment's notice.

As a further protection against power failure it will be noted from the single-line diagram that the emergency feeders and the normal feeders may be operated from either of the two substations of the Montana Power Company serving the mining property. Thus trouble in either of the substations or failure of power supply to either will not cause an interruption of long duration on the pumps or fans. Service to the two substations supplying the mines and a third serving primarily the city of Butte is backed up by seven high-tension sources of power supply, with a switching combination on lines and substations such that power is available from any one of several generating plants widely located geographically. With this arrangement of lines, substation and feeder service interruptions to the mines have been practically non-existent.

As an example of the feeder and distribution system in a mine, the Leonard mine is typical, except that only one other mine has emergency feeders and important pumps. In the Leonard mine, as shown in the accompanying schematic diagram, power for ventilating fans, pumps and lights is supplied from underground substations located on the 1,200-ft. and 2,800-ft. levels. The 2,200-volt pump motors are supplied directly off the 2,400-volt bus, whereas fan and lighting circuits are fed from transformers stepping down to 440 volts, three phase, and 110-220 volts respectively. From a bank of three 500-kva. transformers on the 1,200-ft. level a 440-volt fan feeder is carried up to the 700-ft. level and down to the 1,800-ft. level. Similarly a feeder runs to the 1,900-ft. level from a transformer bank on the 2,800-ft. level. Lighting for the entire mine is fed from a 50-kw. transformer on the 1,200-ft. level over a feeder which is tapped at each level. Alternating current is supplied to the mine by two three-conductor, 2,400-volt feeder cables run down a compartment alongside the main shaft. Direct current at 275 volts for trolleys and storage battery locomotive charging stations is furnished by a 75-kw. motor-generator set in the Leonard compressor plant over a feeder entering the mine in a similar manner. In some mines it has been found expedient to locate the motor-generator set underground and equip it for automatic operation by push-button control.





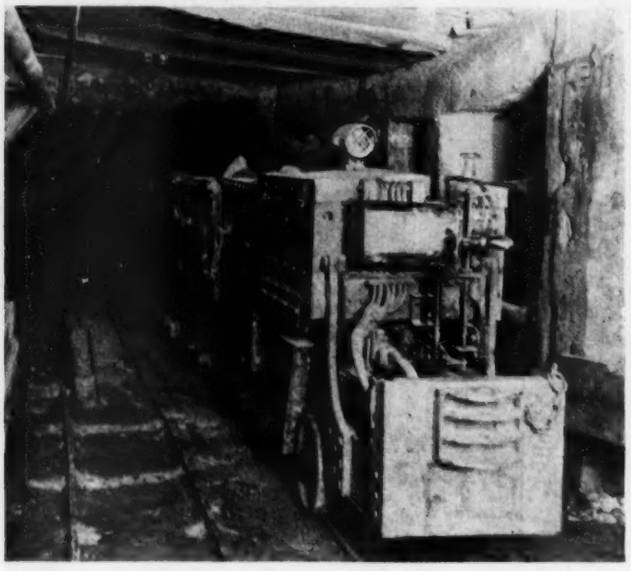
1. JUNCTION BOX INSTALLATION ON SHAFT CABLES. 2. METHOD OF SUPPORTING POWER CABLES IN DRIFTS IN LEONARD MINE. 3. SAFETY TYPE CHARGING PANEL FOR STORAGE BATTERY LOCOMOTIVES

Underground Construction

Safety and reliability of electric service to the mines are dependent almost entirely upon the type of equipment used and the care exercised in its installation and maintenance. The severe conditions under which these underground installations are made and kept in operation are almost unbelievable to those not familiar with copper

mines. The electrical engineer is constantly faced with the problems of moisture due to condensation, mechanical injury and copper sulphate in various degrees of concentration. The problem of moisture due to condensation has been quite successfully solved by the use of gasketed covers on all junction boxes and cabinets, and where these are inadequate, a small resistor or a 10-watt lamp is used to produce a small and continuous heat inside the cabinet. To avoid mechanical injury all cables entering the mine are taken down a gunited compartment provided with ladders adjacent to the operating shaft. The important cables such as the 2,400-volt feeders and the feeder for the haulage system are further protected by steel armor. In some cases a steel-armored cable is used for the 440-volt fan feeders as well. In drifts one of the greatest problems to contend with is mechanical injury due to movement of the earth causing excessive tension on the cables or loosening the armor.

Of all of the forces militating against the successful operation of underground electric circuits in copper mines the action of copper sulphate is the worst. Lead



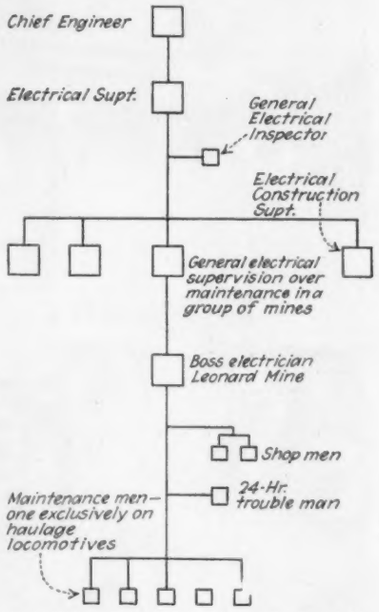
MIDGET STORAGE BATTERY LOCOMOTIVE OF THE MANCHA TYPE, WHICH MAY BE LOADED ON ORE CAGE

is the only metal found that will stand up against the chemical and corrosive action of copper sulphate, and as a result all cables and conductors are lead incased. Even lead after a long period of time becomes brittle and will crack when disturbed. Where steel-armored cables are required for mechanical strength, such as those for the 2,400-volt feeders, each steel armor wire has a thin coating of lead. Except where the lead coating is scraped off due to mechanical injury, this forms a very satisfactory protection for the steel armor wires.

All 2,400-volt mine feeder cables are three-conductor, varnished cambric, lead-covered and leaded steel-armored cables insulated for a working pressure of 5,000 volts. This type of cable has been standard with the Anaconda Copper Mining Company for eight years and to date not one case of failure has occurred. In the Leonard mine two 400,000-circ.-mil cables of this type are carried down a gunited compartment adjacent to the main shaft, as previously mentioned. The cable is supported in such vertical runs by cast-iron cleats covered with cement or by hardwood clamps spaced 10 ft. apart fastened to the mine timbers with bronze lagscrews. In drifts the cable is supported on the vertical mine timbers by similar hardwood cleats or clamps.

At points where the cables are tapped junction boxes with gasketed covers of the type shown in one of the accompanying illustrations are used. Each feeder before tapping the bus at the pumping stations passes through a set of disconnecting switches and an oil circuit breaker with overload and reverse power protection. The two 2,400-volt emergency feeders going down the East Colusa shaft crossing on the 1,200-ft. and 2,800-ft. levels are provided with similar switches and protection and are energized but not normally tied in on the pumping plant buses. Lightning arresters are provided on all 2,400-volt underground buses to drain off any excessive potential that may be built up as a result of frequent summer lightning storms. Truck-type circuit breakers and panels are used for the several 2,400-volt pump motor circuits and the 440-volt transformer bank.

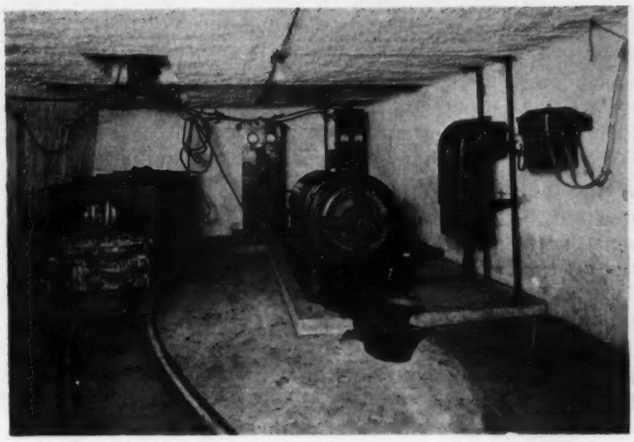
The pumping station on the 1,200-ft. level contains six and the station on the 2,800-ft. level five 600 gal. per minute quintuplex plunger pumps, each driven by two 150-hp., 2,200-volt motors, making the connected load for the two stations 3,300 hp. For all motors of 50 hp. rating and above 2,200-volt motors are standard with the mining company, whereas under 50 hp. 440-volt motors are used. Each of the two transformer banks for 440-volt power consists of three 500-kva. radiator-type transformers located in fireproof rooms adjacent to the pumping stations. Transformer cooling air is circulated by a small turbine-type blower.



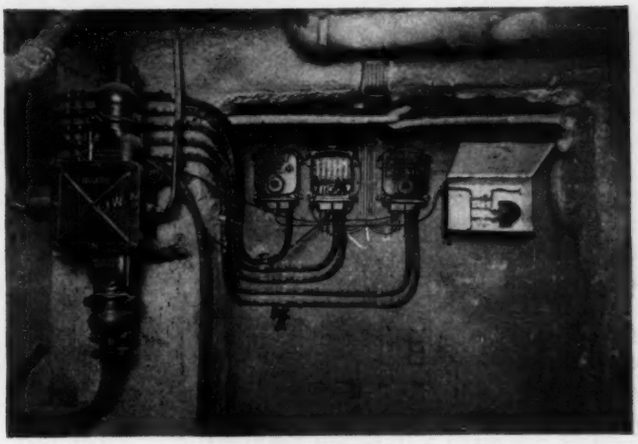
ORGANIZATION CHART OF ELECTRICAL DEPARTMENT HANDLING CONSTRUCTION AND MAINTENANCE IN 28 MINES

All mine ventilating fans are of the turbine type operated by 440-volt motors with push-button control. The feeder for the fan circuits is carried between levels in the cable compartment referred to previously and consists of a three-conductor, No. 4/0, rubber-insulated, lead-covered cable designed for a working pressure of 600 volts. On the levels the fan circuits consist of No. 1/0 cable of similar construction. The method of supporting 440-volt cables in vertical and horizontal runs is the same as that used on the 2,400-volt cables described. In the Leonard mine the connected load of fan motors is 820 hp.

Lighting for the mine is fed from a 50-kw. transformer located on the 1,200-ft. level. A three-conductor, No. 1/0, lead-covered cable insulated for 600 volts is run between levels in the vertical cable compartment



UNDERGROUND MOTOR-GENERATOR SET USED FOR OPERATING HAULAGE SYSTEM



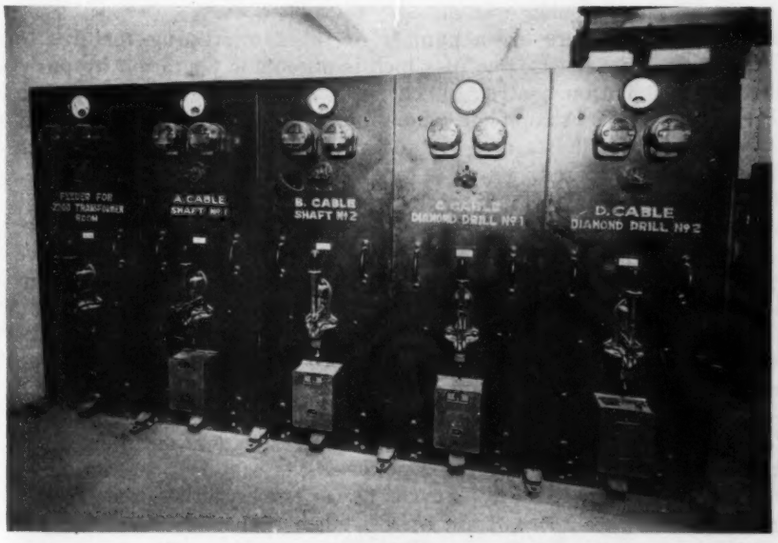
SPECIAL SIGNAL CABINETS (CENTER) DEVELOPED FOR MINE SIGNAL SYSTEMS

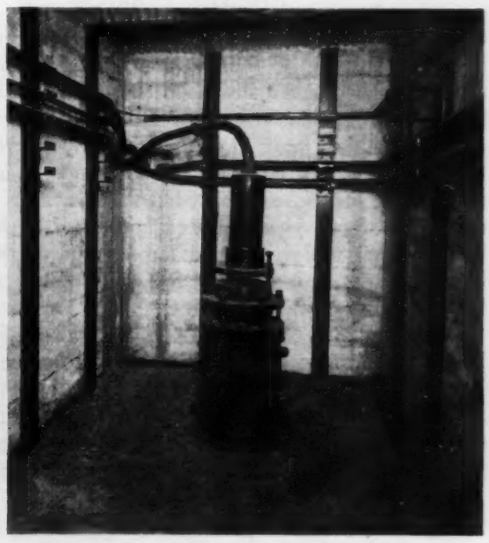
with the other cables. At each level this cable is tapped into a distribution cabinet, and from this two-wire, 110-volt, rubber-covered circuits starting with No. 4 wire and reducing to No. 8 are carried through the drifts attached with porcelain knobs to the under side of the overhead cross-timbers. Short leads from waterproof composition sockets are tapped directly to the lighting circuit.

Direct current at 275 volts for the haulage system is supplied over a two-conductor, 250,000-circ.mil, lead-covered cable with leaded-steel armor carried down into the mine in the cable compartment. At each level this feeder is tapped for the trolley or the storage battery-charging stations as required. Both sides of the circuit pass through a disconnecting switch, one wire then going directly to the rails of the tram system and the other passing through a magnetic blow-out, hand-operated circuit breaker. If the tap is for a battery-charging circuit, the same protection is used and both sides of the circuit are carried through the drift in a two-conductor, No. 4, lead-covered cable attached to the mine timbers with hardwood cleats.

All switches, motor-starting panels, storage battery-charging panels, etc., used in underground construction are of the safety or dead-front type, to minimize to the greatest possible extent the hazard to the workmen. All underground haulage in the Anaconda mines is done with either trolley type or storage battery locomotives. In the 28 mines there are 143 trolley locomotives, 80 standard size, 5-ton storage battery locomotives and sixteen $\frac{1}{2}$-ton midget storage battery locomotives. The midget type, one of which is shown in an accompanying illustration, is a comparatively recent development. It is so designed that it can be moved from one level to another on the cage above the ore skip. This is of considerable advantage in some mines where mining on certain levels is not continuous or where the mine as a whole may be shut down for a time.

Trolley locomotives are gradually being replaced with the storage battery type because of the many advantages of the latter. Capital cost of the two types is about the same, as the expense of erecting trolley and bonding the track just about equals the price of the storage battery. Energy for charging the storage batteries costs the mining company practically nothing, as the load is off-peak, whereas a large part of the trolley locomotive load comes on the mining load peak. However, perhaps the greatest advantages of the storage battery locomotives lie in the elimination of excessive trolley maintenance; hand tramming from the working sills to the end of





AT LEFT, TRUCK-TYPE FEEDER PANELS IN UNDERGROUND MINE PUMPING STATION. AT RIGHT, POTHEAD FOR SUPPORTING DIAMOND DRILL HOLE CABLE IN HIGH-ORE MINE

the trolley; fire hazard, and the very great hazard to life due to accidental contact with the trolley. The high cost of maintaining trolley may be judged from the fact that in bad drifts one electrician and two carpenters are required to keep the trolley up and in safe working condition due to falling rock from mining operations. The battery locomotives were first used in the Anaconda mines in 1919 and all new locomotives purchased recently have been of this type. Eventually all of the trolley locomotives may be eliminated.

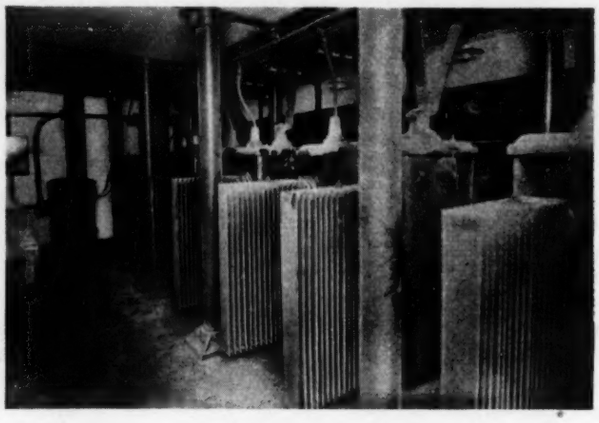
Maintenance costs on the battery locomotives may be slightly higher than on the trolley type due to the battery care required, although considerable trouble is experienced with armature and field coils on the trolley locomotives due to the higher operating voltage. Trolley locomotives are given a thorough inspection once every two weeks; battery locomotives are inspected twice a week and get a thorough overhauling every six weeks in accordance with the maintenance schedule previously mentioned. Once every fifteen to eighteen months each locomotive battery is taken to a central battery shop for a careful overhauling and washing, after which is is painted.

Battery locomotives are charged from charging panels located on the levels where they are used. These panels are of a safety type developed especially for mine use, with dead-front panel, waterproof roof and screened sides. A charging station consists of a dead-front panel, safety switch, two-pole circuit breaker with no voltage release and reverse power protection, iron grid rheostat for controlling the charging current and a voltmeter and an ammeter. The charging rate is set by an authorized person and the batteries are placed on charge and taken off by the locomotive operator. An ampere-hour meter on the locomotive indicates the state of charge of the battery and a contact made when the meter has been returned to zero automatically trips the circuit breaker on the charging panel and prevents overcharging. The batteries receive their regular charge between 2 a.m. and 8 a.m. and a booster charge between 4 p.m. and 6:30 p.m. during change of shifts. If the locomotive is on unusually heavy haulage service, a 30-minute booster charge is given the battery at 12 noon and 10 p.m. during the lunch period.

Electric Hoisting

Upon completion of an electric hoist installation now being made, six of the 28 ore hoists in the Anaconda mines will be electrically operated. Three of the electric hoists now in operation are 2,800-ft. General Electric-Norberg hoists and have been in operation for some time. Of the three other installations, one is not yet completed but is scheduled for operation during the early fall of this year. This is a 5,000-ft. Allis-Chalmers hoist, which will replace an air engine at the Mountain Consolidated mine. A 5,000-ft. General Electric-Norberg hoist was placed in operation at the Badger State mine on Aug. 15, 1927, and a similar hoist has been in operation at the Belmont mine since May, 1927. Both hoists replaced steam equipment, and the one at the Belmont mine, which has been in service a sufficient length of time to secure operating costs, has shown an operating cost of less than one-fifth that of the former steam equipment.

The hoist installation at the Belmont mine consists of a double-drum ore hoist driven by a 2,150-hp., separately excited, direct-current motor supplied by a 1,650-kw. motor-generator set using the Ward Leonard system of speed control. The man or "chippy" hoist is driven by a 1,050-hp., direct-current motor supplied by an 800-kw. motor-generator set with similar control. Two new and important features have been incorporated in their design. Elimination of the usual bulky flywheel on the motor-generator set provided for the purpose of lessening the maximum power demand of the hoist during acceleration was made possible by the fact that the mining company purchases such a large block of power that the importance of momentary high demands on individual pieces of equipment is mitigated. A second feature is the application of dynamic braking to the main hoist motor by connecting a resistance in two steps directly across the motor armature. Perhaps the greatest advantage of dynamic braking is that it will prevent the hoist from running away in case of alternating-currrent power failure should the hoist be lowering unbalanced—that is, lowering one skip only. Moreover, safety devices and controls are so arranged



UNDERGROUND INSTALLATION OF TRANSFORMERS SUPPLYING 440-VOLT POWER

that dynamic braking will be applied in case of overwind or overtravel of the hoist cages, extreme direct-current overvoltage, failure of hoist motor field, failure of exciter voltage, overspeed of the motor-generator set, failure in the control circuit or opening of the hand emergency switch.

There are a number of other interesting features to the hoists, one of which is automatic operation by push-button control, which space here will not permit taking up. A complete tabulation of the electrical equipment of the hoists and test data for this apparatus have been prepared.

Mine-Signaling System

Reliability, safety, simplicity and ease of repair have been the prime factors in guiding the Anaconda company in the development of its mine-signaling system. Two separate and independent signal systems are installed in each shaft for use of the station tender, who rides on the cages when men or supplies are being moved or is stationed at the skip pocket for dispatching the skips when ore is being hoisted. One is an alternating-current system for station bells and is operated from the 110-volt, 60-cycle power supply; the other, called the direct-current or shaft bell system, is supplied by a dry cell battery of 18 to 20 volts. Normally all signaling is done on the alternating-current system, the direct-

current system being held in reserve in case the alternating-current system becomes inoperative for any reason. Supplementing these two main systems is a buzzer system operated by 110 volts, alternating current, used for signaling the cage tender from any one of the levels in the mine.

Confusion in the use of the three systems is avoided by adopting a standard arrangement for the location of the pull switches. The alternating-current pull switches are furnished with short ropes and are located on the station posts within easy reach of the cages. The direct-current pull switches, also located on the station posts, are furnished with long ropes, which extend down the shaft to the next station, so that if it is necessary to stop a cage between levels the tender will be able to signal the engineer. Pull switches for the alternating-current buzzer call system are located approximately 25 ft. back from the shaft at each station, as this system is not used by the cage tender.

At the engineer's stand in the hoist room there are two sets of three bells each. One is for the alternating-current station pull switches, there being a bell for each of the pull switches in the two main shafts and one for the switch in the auxiliary shaft. Likewise there is a bell for each of the direct-current shaft pull switches. Different tones to the bells enable the engineer to identify the signals. In addition to the bell signals in the hoist room there is a buzzer operated by the alternating-current buzzer call system.

Besides the bell and buzzer systems there is a mine telephone system with instruments on each operating level. Standard mine telephones of the magneto type such as those made by several manufacturers are bridged across two spare wires in the direct-current signal cable. In the High Ore and Leonard mines, where important pumping stations are located, a separate telephone system has been provided for communication between the pumping stations and the surface.

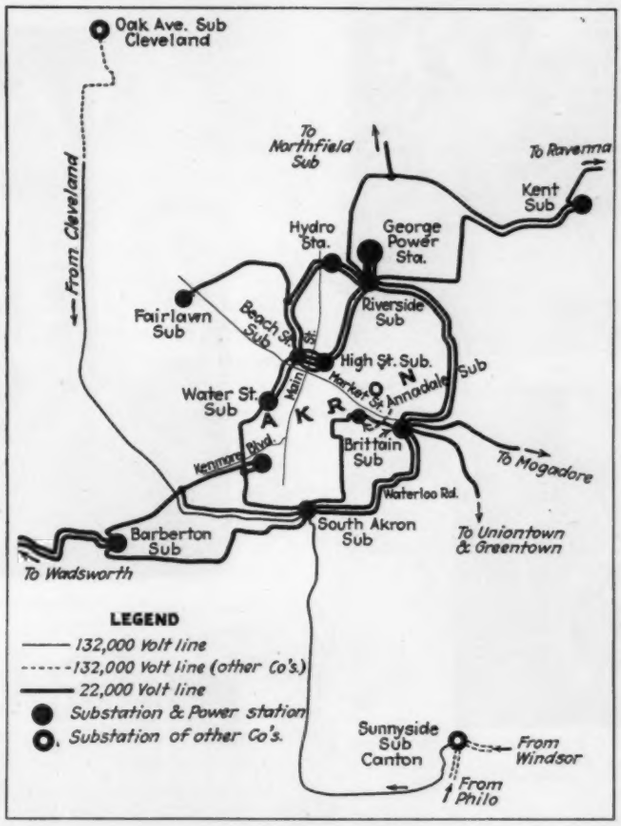
Each cable for the two main signaling systems contains six flexible No. 12 conductors, insulated for 600 volts and incased in a $\frac{1}{16}$-in. lead sheath. Over the lead sheath is a layer of jute, upon which two steel armor tapes are applied in opposite directions. The cable as a whole is protected with a layer of hard twisted asbestos drawn through fireproof paint. The cable for the alternating-current buzzer system is of similar construction, but contains only three No. 8 flexible wires. All two-conductor taps for pull switches, buzzers, etc., are solid No. 12 rubber-insulated wires laid parallel and covered with a $\frac{1}{16}$-in. lead sheath. A color system in the six-conductor and the two-conductor cables facilitates tracing circuits.

Junction boxes are of cast iron with gasketed covers and all entrances are sealed so that the boxes are water tight. Where trouble is experienced with moisture due to condensation, 10-watt lamps are kept burning in terminal and junction boxes for the main signal systems. Two spare wires in the six-conductor alternating-current signal cable are used for 110 volts to supply the lights in both the alternating-current and the direct-current system cabinets. The lights are placed directly back of a bossed hole fitted with a green glass in the cabinet covers indicating plainly an alternating-current failure on the signal system. Cabinets for the alternating-current buzzer call system are kept dry by a small porcelain-coated resistor tapped directly across the 110-volt circuit. Signal cables are supported every 10 ft. by cast-iron cleats in vertical runs and are placed in the same vertical cable compartment as the power cables. Alternating current for the signal system is supplied by a separate signal transformer at the surface of the mine.

Much of the special apparatus used in the signal systems and for power distribution in the mines and many of the methods employed in underground construction were developed after considerable study by engineers of the Anaconda Copper Mining Company.

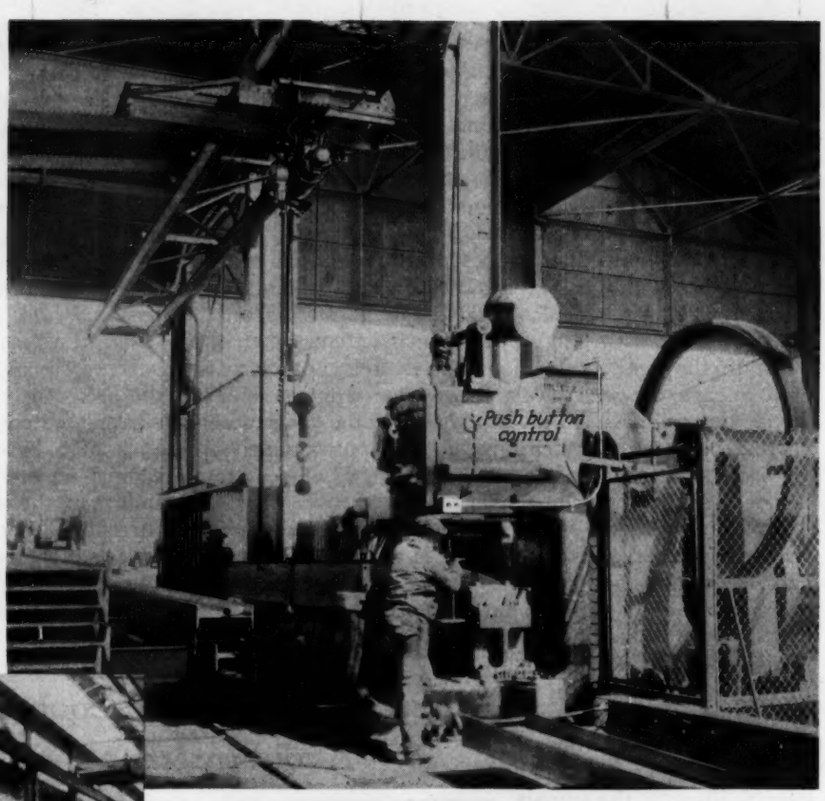
Although this article has dealt only with power supply and electrical applications in the mining of copper ore there are other equally important and economic uses of electricity that enter into the reduction, smelting and refining of copper and the manufacture of finished copper products. The facts that the ore is mined with electrically compressed air, hauled to the skips by electric locomotives, hoisted electrically, transported to Anaconda over an electrified main line haulage railroad, reduced in an electrically driven mill, roasted and smelted with electrically driven machinery, refined at Great Falls electrolytically and rolled and drawn into wire in an electrically operated wire mill, give one some idea of the important part which electrical energy plays in the copper industry.

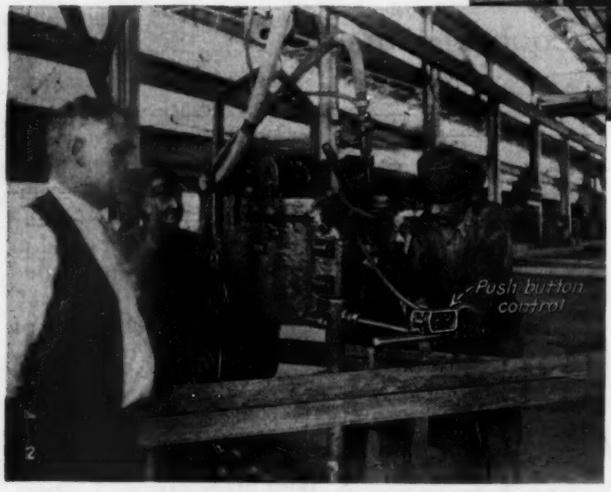
Interconnections and Loop Circuits Avoid Interruptions

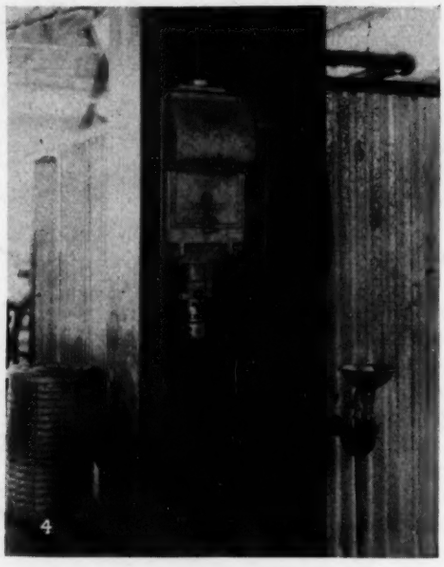


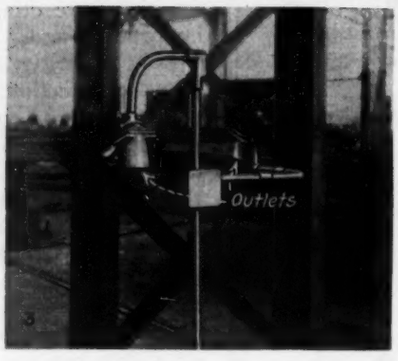
HIGH-VOLTAGE transmission lines connect the system of the Northern Ohio Power & Light Company, of Akron, to the systems of the Ohio Power Company in Zanesville, and the Cleveland Electric Illuminating Company, of Cleveland, offering protection of supply from two directions. A multiple loop surrounds the city of Akron, as shown, so that 22,000-volt service will always be available at local substations.

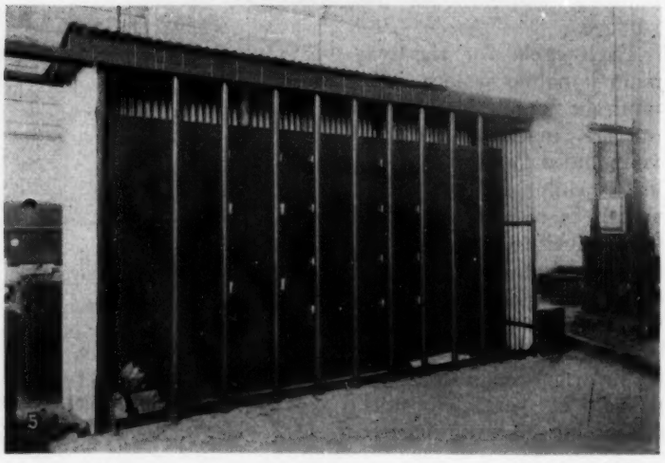
Push-Button Controls, Conveniently Situated and Readily Accessible Outlets for Portable Tools and Appliances, Aid Work at Union Iron Works











No. 1. Push-button crane control reduces time one-third for punching heavy I-beams

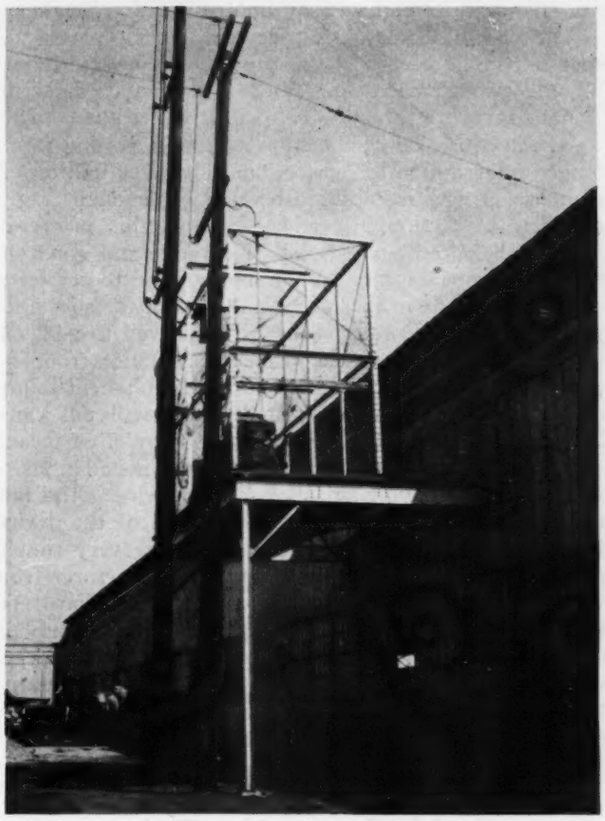
No. 2. Push-button control for gantry crane supporting compression riveter increases production 200 per cent

No. 3. One of eight electric welding outlets conveniently located in steel-fabricating plant

No. 4. Outlets for portable reamers placed on building supporting columns

No. 5. Dead-front distribution board protected with iron pipes against mechanical injury.

Push-Button Crane Control Speeds Production



TRANSFORMER RACK AT UNION IRON WORKS, LOS ANGELES, CAL.

BY AN ingenious arrangement of push-button controls for small cranes the Union Iron Works, of Los Angeles, has been able to reduce labor and increase production in several steel-fabricating processes. In punching rivet holes in large I-beams the usual method has been to balance the beam in a chain sling from a floor-controlled crane and then feed the beam through the punch by pushing and pulling until the beam was in position for punching. As the crane would nearly always move too far or not far enough, this method naturally required many seconds to get the beam in exact position for punching.

This operation in the new plant of the Union Iron Works has been speeded up one-third by push-button control on the travel motor of the crane so that the operator has full control of the longitudinal movement of the I-beam by simply pressing one of two conveniently located push buttons. Control of the 2-hp. worm-drive crane travel motor is accomplished by magnetic contactors which operate the motor in either direction as long as the push button is depressed.

By similar control on the 5-hp. travel motor on a gantry crane the capacity of a compression riveter supported by the crane has been increased 200 per cent, according to John Bertone, superintendent of the plant. The push-button control, as may be seen from one of the accompanying illustrations, is mounted on a projecting arm from the riveter, under the hand of the operator, so that the bulky riveter is quickly moved back and forth until in exact position for riveting.

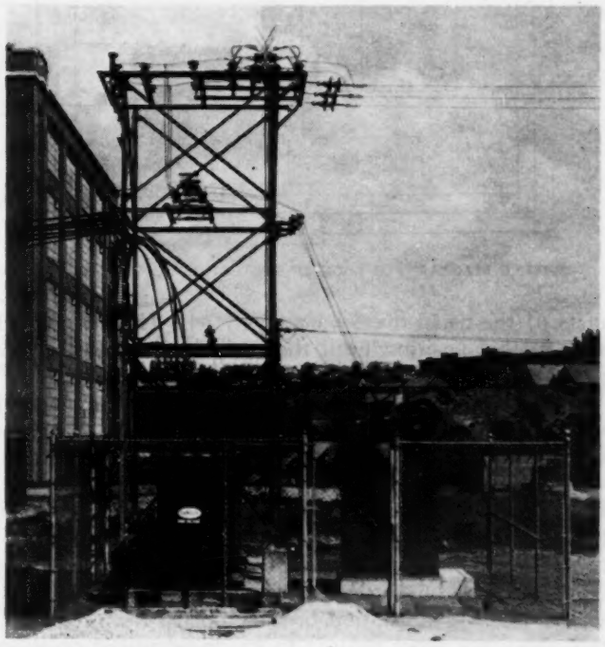
Several other interesting features in the plant are shown by the accompanying illustrations, such for instance, as outlets for electric welding, outlets for portable reamers and other equipment, protected dead front distribution board, main power and lighting distribution board and push-button control for all motors.

Lock-in Relays Minimize Breaker Duty

Primary breakers do not operate on a short circuit exceeding rupturing capacity of switch. Installation costs reduced. Operating factors satisfactory

By William A. Tripp
Engineering Department, Blackstone Valley Gas & Electric Company, Pawtucket, R. I.

LOCK-IN relay protection is used on the system of the Blackstone Valley Gas & Electric Company with the object of preventing the opening of primary circuit breakers in case the short-circuit current is above the rupturing capacity of the breaker. The advantages of lock-in relay protection are obvious. It permits the use of a much smaller breaker at customers' substations, thereby saving the expense of installing breakers large



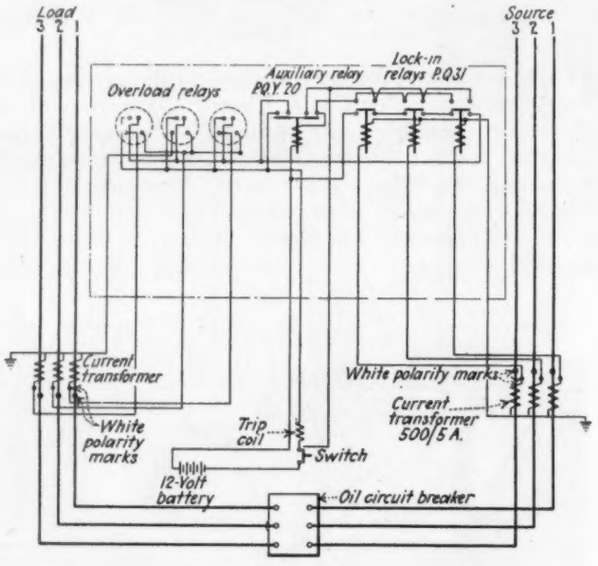
DESURMONT WORSTED MILL SUBSTATION EQUIPPED WITH LOCK-IN RELAYS

enough to handle primary short circuits. Since primary shorts are very rare, the installation of equipment to handle them is practically "dead investment." In some substations the size of breaker necessary to handle primary short circuits would have to be practically equivalent to the main station breaker. It is estimated that the use of sufficiently large breakers and necessary auxiliary equipment in many of our substations would cost slightly over 50 per cent more than a smaller breaker

with lock-in relay protection and necessary auxiliary equipment.

As installed in the company's industrial substations, a breaker with lock-in relay protection requires the following equipment: (1) The usual overload protection in the form of inverse time-delay overcurrent relays; (2) lock-in protection in the form of instantaneous pick-up, self-resetting, overcurrent relays; (3) an auxiliary direct-current instantaneous pick-up self-resetting relay, and (4) a low-voltage direct-current tripping system.

The action is as follows: (1) When a short-circuit occurs, the usual overcurrent relays start timing. (2) If the current is above the rating of the breaker in one or more of the phases, one or more of the lock-in relays will pick up, thus opening the tripping circuit of the breaker and preventing it from opening on the short. (3) After one or more of the lock-in relays has picked up, the auxiliary relay will pick up and shunt the tripping con-



WIRING DIAGRAM FOR LOCK-IN PROTECTION AT DESURMONT

tacts of the usual overload relays. (4) The system will stay in this position until the main line breaker at the power station or other source of power has opened. (5) When the main line breaker opens, the current through the substation breaker into the short circuit drops to zero, and the overload and lock-in relays return to their de-energized position. (6) When all the lock-in relays have returned to their de-energized position, the tripping circuit of the breaker is completed through their contacts and the contacts of the direct-current auxiliary relay, and the substation breaker opens against no duty. (7) When the substation breaker opens, the direct-current auxiliary relay returns to its de-energized position. (8) Since all this action after the opening of the main power station breaker has been accomplished by means of instantaneous relays, the substation in trouble is cleared from the line before the station operator or automatic reclosing equipment has time to reclose the source breaker, and this breaker accordingly comes back on a "clear line." The substation in trouble remains dead until a trouble man comes out, clears the short and closes the substation breaker. The trouble call from the customer of the dead substation will, of course, locate the affected substation for the trouble man.

Certain requirements must be fulfilled with this scheme:

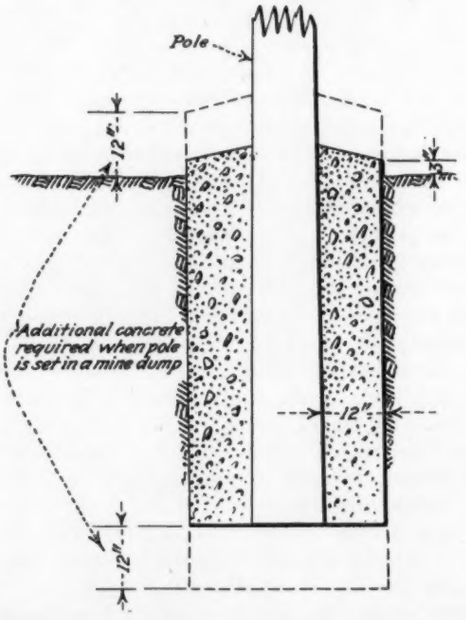
1. The substation breaker must be large enough to handle short circuits occurring on the secondary side of the substation, without lock-in relay protection.

2. The available current for a short on the primary must be large enough to trip the main station breaker.

The one disadvantage of the use of lock-in relays is that if trouble occurs in the primary of one substation, all substations on that line suffer a momentary interruption to service. This, of course, is better than having too small a breaker at the substation and causing a prolonged interruption to service due to breaker failure. In comparison with installing a breaker big enough to give complete protection, the added cost of this protection must be balanced against loss of revenue and good will resulting from the momentary interruption to service at other substations in the rare event of primary substation trouble. In this connection, it may be well to add, one of the commonest causes of primary substation trouble—namely, a bushing failure or other such equipment failure causing a single line to ground fault—will not cause lock-in relay action, but is taken care of by other means.

One weakness in the economies of the installations of any investment-saving or labor-saving device is the failure to evaluate the test and upkeep costs of the device. In the present instance the relays used are very simple, are standard articles of the particular manufacturer from whom they were bought, and are of a familiar type, known to give little trouble. They must be tested periodically, but a very simple test arrangement has been worked out by which their test is hardly more than incidental to the testing of the already installed usual overload relays and adds only a few minutes to the time of inspection.

Stable Setting for Poles



WHEN exceptionable stability of poles is required, the West Penn System requires an artificial foundation of concrete around the base of the pole as shown. The mixture consists of one part portland cement, two and one-half parts sand and five parts broken stone and clean gravel. When poured, the mixture contains enough water to make it flow freely and take its place without tamping. The pole is braced until the concrete is hard.

LIMESTONE IS HANDLED BY ELECTRIC SHOVEL AND STORAGE-BATTERY LOCOMOTIVE

Cement Plant—A Large Power User

Phoenix Portland Cement Corporation in Birmingham has 4,000-bbl. capacity, uses 7,500 hp. and has 3,000-kw. demand. Very large grinding mill and kiln drives

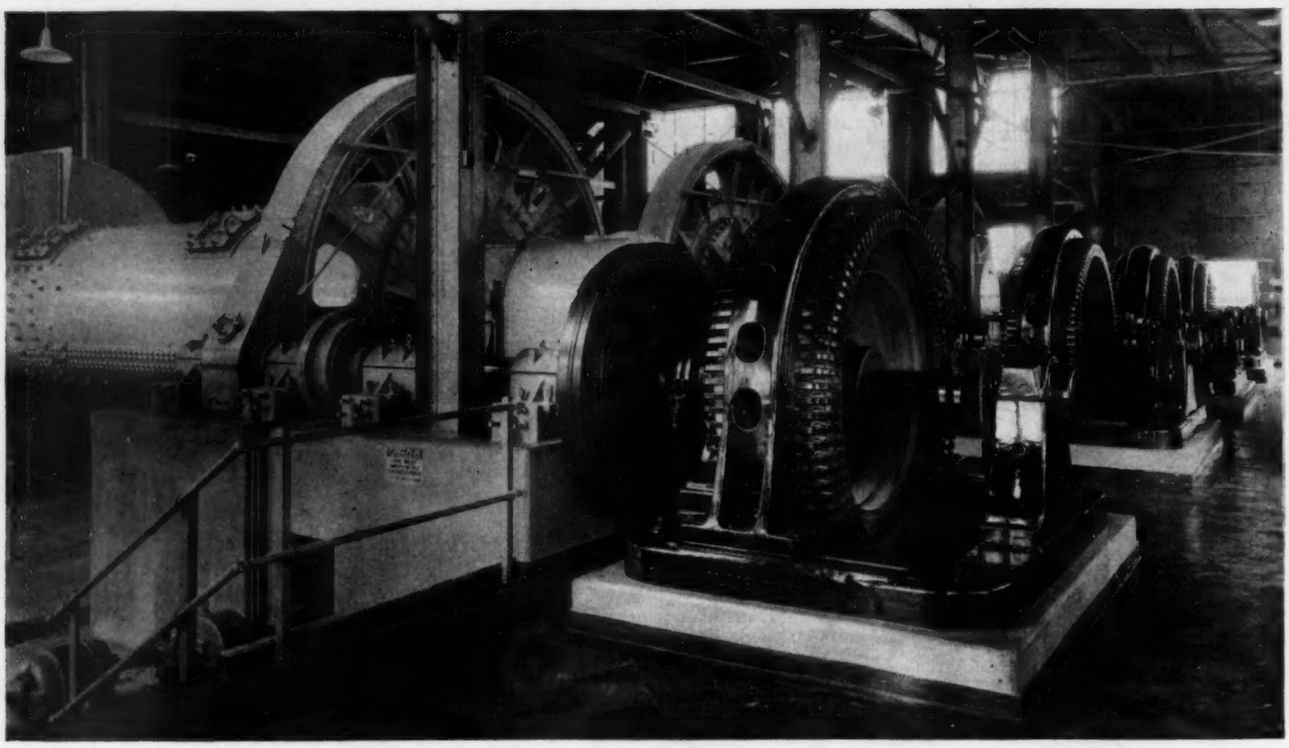
THE manufacture of portland cement has certain features that differentiate it commercially from almost every other industry. The raw materials underlie nearly one-quarter of the United States, thus making their initial cost low. As a result the cost of the finished cement is determined almost entirely by the actual costs of the different operations through which the raw materials pass. Experience has shown that the most efficient, economical and successful means of operating is to have a well-designed electric drive throughout, with such a plant layout that material flows from quarries to cement storage and packing with as little waste motion or handling as possible.

A striking and recent example of a modern cement installation is the new plant of the Phœnix Portland Cement Corporation, placed in operation last January at Birmingham, Ala. No detail was overlooked to make this plant the finest that present knowledge of the art permitted. Large units were used throughout, as they are considered more efficient than small units. An intensive study was made of machine grouping to minimize labor and supervision costs. Cement machines and their drive were chosen and installed so that maintenance and repair costs would be reduced to a minimum. Æsthetic values, sanitation, freedom from dust and comfortable working conditions were also considered. Notwithstanding all this, the executives declare that the initial cost per barrel of output is not more than that of any of the modern plants.

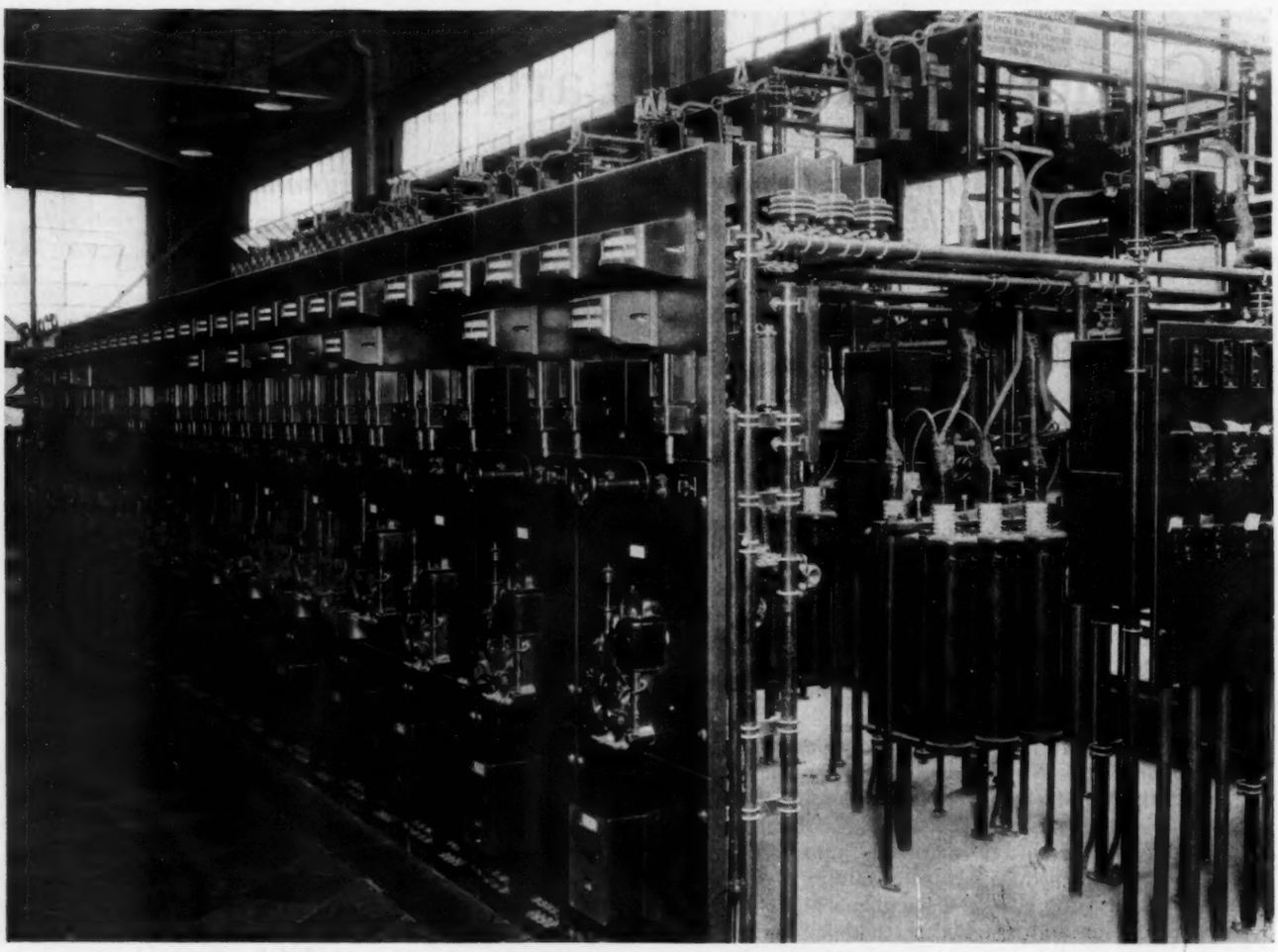
The plant is laid out along four parallel lines: The first group includes the quarry, crusher house and raw-material storage building, and coal mill; the second includes the grinding mills, kilns and stack; the third, the auxiliary building, outdoor substation and the various slurry correcting, mixing and storage basins; and the fourth, the 160,000-bbl. silos, packhouse and baghouse.

Connected Load and Demand

The major equipment with its electrical drive is given in the accompanying tabulation. The various processes through which the raw materials go from quarries to packhouse may also be followed in this table. The total connected load in the different departments of the plant are as follows: Limestone quarry, 462½ hp.; limestone-crushing plant, 882 hp.; shale and sandstone quarry and crushing plant, 310 hp.; raw material and clinker storage, 460 hp.; mill building, 4,709 hp.; slurry handling and mixing, 196 hp.; kiln house, 510 hp.; coal mill, 333 hp.; storage and packing house, 362 hp., and miscellaneous equipment, 163 hp. This makes a total connected load



GRINDING MILLS, DRIVEN BY 800-HP. 2,200-VOLT SYNCHRONOUS MOTORS THROUGH MAGNETIC CLUTCHES



MAIN CONTROL SWITCHBOARD FOR CEMENT MILL LOCATED IN GRINDING BUILDING. THIS COMBINATION MADE POSSIBLE BY USE OF DUST COLLECTOR

of 8,387½ hp., but the motor-generator sets in the mill building supplying direct current to the kiln-house motors should be deducted, as these motors are included in the figures cited, leaving a total connected load of 7,517½ hp.

The average maximum demand for normal operation is about 3,000 kw. The maximum demand is automatically controlled by overpower and definite time relays. These relays are set somewhat above 3,000 kw. and operate to cut out some equipment after five minutes if the predetermined maximum demand is exceeded for that length of time.

Energy Supply

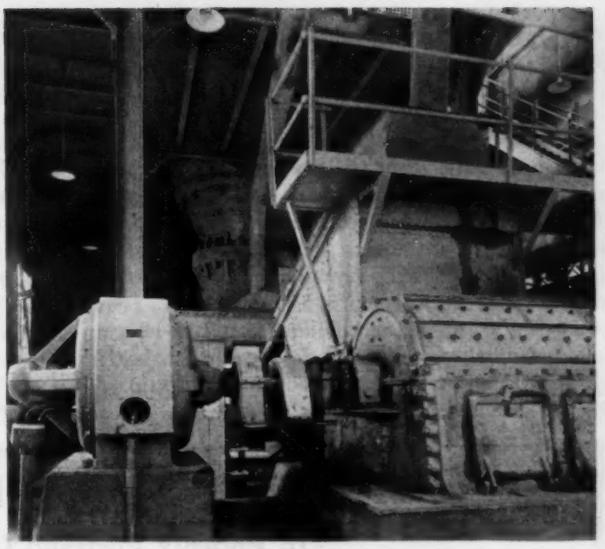
The main energy supply to the plant is afforded through two 13,200-volt lines of the Birmingham Electric Company from the Magella substation, about 5 miles away. At a point near the cement plant one of these lines taps into another 13,200-volt line running from the utility's power plant in Birmingham to Bessemer. The two supply lines terminate in an outdoor substation equipped with three 1,667-kva., single-phase, 13,200/2,300-4,000-volt conservator-type transformers.

The two incoming lines are connected through air-break switches to a 25,000-volt, 400-amp. oil circuit breaker, common to both. The high-voltage side is protected by choke coils and oxide-film arresters. The oil breaker may be bypassed by an air-break switch. The low-voltage side of the transformers is connected in delta direct to the 2,200-volt bus, from which are taken four three-conductor 750,000-circ.mil cables. These cables run through oil circuit breakers (one breaker for two cables) to the main bus at the main switchboard in the mill building. Besides controlling all equipment in the mill building, the switchboard supplies seven distribution centers located in the crusher house, storage building, coal mill, etc. Three-conductor armored cable is used to these distribution centers. At each of these points are oil switches for 2,200-volt power when this is required and transformers for 440-volt, three-phase power and 110-volt, single-phase lighting.

The mill building, where the main switchboard is located, is one of the features of the plant on account of the large size of the raw and finish grind mills and the combination of the grinding department and the main control board for the entire plant. This combination is made possible by keeping the mill building completely free from dust by means of a dust collector. Considerable saving in man-hours is made by this arrangement. Two men and an oiler do everything connected with mixing, grinding and handling of slurry in addition to substation details. One man is stationed on the miller's or poidometer platform and looks after the proportioning of materials and mill feeds and the other watches the switchboard and auxiliary equipment.

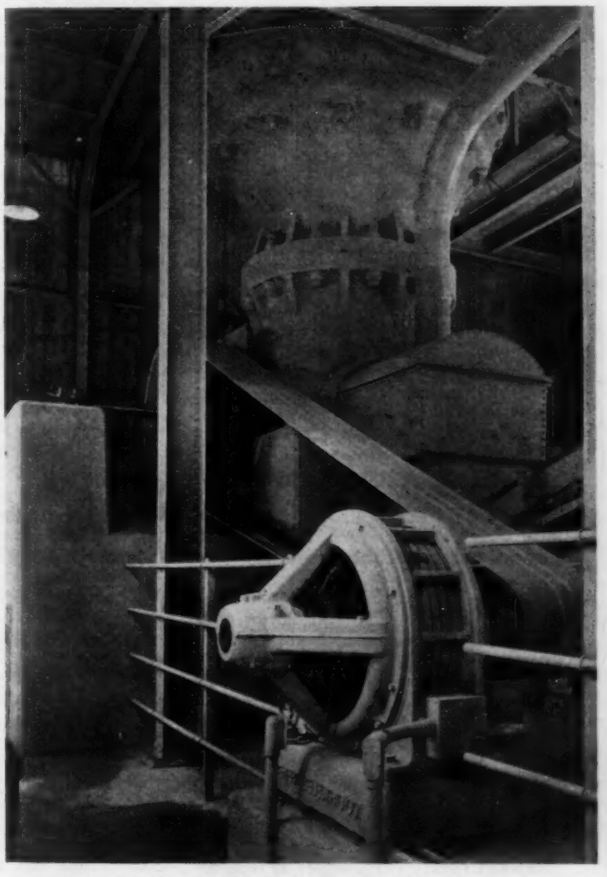
800-Hp. Motors Drive Grinding Mills

The four grinding mills, two for raw materials and two for finished materials, are believed to be the largest of their kind for use in the cement industry. Each mill is of the compeb type and is of 40 ft. long. The first compartment is 9 ft. long and 8 ft. in diameter and the remaining 31 ft., containing the second and third compartments, is 7 ft. in diameter. Each mill is driven by an 800-hp., 2,200-volt synchronous motor through a 72-in. magnetic clutch. It is interesting to note that the bearings of these mills are designed for a pressure of 200 lb. per square inch only. The grinding in the raw mills runs about 35 per cent through 200 mesh in the first compartment, 60 per cent to 70 per cent in the second and 90 per cent in the third. In the finishing mills grinding is carried about ten points finer than standard specifications required, or to about 88 per cent through 200 mesh.



HAMMER MILL, WHICH REDUCES CRUSHER DISCHARGE TO MILL FEED

Located in the mill building are also two air compressors driven by synchronous motors and two 435-hp. motor-generator sets for supplying 230 volts direct current to the kiln house. One of these sets may be connected through a clutch to a 300-hp. gasoline engine for



PRIMARY 42-IN. GYRATORY LIMESTONE CRUSHER, DRIVEN BY 200-HP. MOTOR

supplying direct current to the kiln house should the main power source be interrupted.

Kilns Driven by 100-Hp. Motors

Another feature of the plant is the size of the two kilns used (see page 650). These kilns were to be 330 ft. long, but additions were made to include coolers. As changed each kiln is 343 ft. 9 in. long, 11 ft. 3 in. in diameter for the first 120 ft. at the hot end and 10 ft. in diameter for the remainder of the length. The total weight of each kiln shell is 550 tons. Five bearings, each consisting of a ring and rollers with 3-ft. bearing surface, are provided, together with one thrust bearing at the center. Each kiln is driven by a 100-hp. adjustable-speed direct-current motor, but actual measurements show that but 60 hp. of this capacity is required for normal operation.

In the first 112 ft. of the slurry feed end of the kiln there is 4,000 ft. of $\frac{7}{8}$-in. chain suspended in loops, the main purpose of which is not only to agitate the slurry and break up rings but also to transfer heat. That they are effective for transferring heat is shown by the fact that the temperature of the gases measured at the mouth of the kiln varies from 600 deg. F. to 700 deg. F. These chains also have the added advantage of acting as dust collectors.

The two kilns were designed to have a total capacity of 4,000 bbl. of cement per day, and since the plant has been in operation produce this without being crowded. As much as 4,300 bbl. has been turned out in a day's run.

Major Equipment

In Phoenix Portland Cement Corporation's Plant Birmingham, Ala.

General Information

All electrical equipment was supplied by the General Electric Company with the exception of the four raw and finish mill motors, which were supplied by the Allis-Chalmers Manufacturing Company, and the kiln department by F. L. Smidth & Company. The kiln control was laid out by the electrical department of the same company. Wherever speed reducers were required between motors and equipment they drive, Falk herringbone type were used.

Limestone Quarry

Total connected load, 462½ hp.

Type 100-B Bucyrus caterpillar electric shovel with Ward-Leonard control, each motor having its own generator separately excited. Main equipment consists of one 190-hp., 2,200-volt, 1,200-r.p.m. motor direct connected to one 100-kw. hoist generator, one 24-kw. crowd or thrust generator and 25-kw. swing generator, all generators being 250 volts direct current. Generators separately excited by 5⅝-kw. motor-generator set driven by 7½-hp., 440-volt motor. Hoist, swing and crowd motors are respectively 125 hp., 30 hp. and 30 hp., 230 volts direct current. Dipper trip motor is rated at 25 ft.-lb. and 440 volts alternating current. Shovel has one 10-kva., three-phase 2,200/440-volt transformer for 440-volt power and one 2-kva., single-phase, 440/110-volt lighting transformer.

Two 9-ton General Electric storage battery locomotives rated at 3,200-lb. pull, 3.5 miles per hour and 170 volts. Battery of 88 cells, each rated at 340 amp.-hr. and are of the Exide iron clad type.

Storage battery charger for locomotives is a 50-hp., 2,200-volt motor-generator set delivering 250 volts direct current.

Two clipper well drills, each driven by 15-hp., 440-volt, 1,200-r.p.m. motor.

Limestone-Crushing Plant

Total connected load, 882 hp.

Steward Manufacturing Company quarry car hoist driven by 225-hp., 2,200-volt, 225-r.p.m. to 600-r.p.m. slip-ring motor.

Steward rotary car dumper driven by 10-hp., 440-volt, 900-r.p.m. motor.

Superior McCully 42-in. gyratory crusher made by Allis-Chalmers Manufacturing Company, belt driven by 200-hp., 2,200-volt, 600-r.p.m. motor.

Crusher discharge falls onto 48-in. Link-Belt apron conveyor driven at 50 ft. per minute by 15-hp., 440-volt. 720-r.p.m. motor.

Crushed rock falls into No. 9 Jumbo Williams hammer mill, driven by 350-hp., 2,200-volt, 900-r.p.m. motor.

Mill discharge taken by 250-ft. per minute Link-Belt conveyor, driven by 30-hp., 440-volt, 900-r.p.m. motor, and discharges into storage bins. This conveyor is 350 ft. center to center.

"Norblo" dust collector with five motors totaling 47 hp.

Hoist motor above gyratory crusher rated at 5 hp. and 440 volts for handling rocks too big to go through crusher.

Shale Quarry and Crushing Plant

Total connected load, 310 hp.

Located about 15 miles from cement plant.

Type 20 Bucyrus electric shovel operated by one 40-hp. hoist motor, one 15-hp. swing motor and one 15-hp. crowd motor, all 440 volts alternating current and 900 r.p.m.

Vulcan 7-ton gasoline locomotive with four speeds.

McCully 20-in. gyratory crusher, belt driven by 60-hp., 2,200-volt, 900-r.p.m. slip-ring motor.

No. 5 Jumbo Williams hammer mill, driven by 150-hp., 2,200-volt, 1,200-r.p.m. slip-ring motor.

Between crusher and hammer mill is a 32-in. belt elevator, driven at 110 ft. per minute by 15-hp., 440-volt motor.

Chain elevator for finished shale with 16-in. buckets, driven by 15-hp., 440-volt motor.

Raw Material and Clinker Storage

Total connected load, 460 hp.

Storage building 468 ft. long and 80 ft. wide with bins for limestone, sandstone, shale, gypsum and coal storage, together with mixing bins.

Material handled by two Whiting 3-yd. traveling cranes with 2½-yd. Blaw-Knox buckets. One crane for raw materials and other for coal and clinker. Each crane has two 80-hp., one 40-hp. and one 15-hp. motors, all 440 volts.

Shale and sandstone brought 15 miles to plant in standard bottom-dump railway cars. From track hopper material is discharged into storage bins by chain elevator, 43 ft. center to center, 16-in. buckets and driven by 15-hp., 440-volt, 600-r.p.m. motor.

Gypsum taken from another track hopper by elevator, 26 ft. center to center, driven by 15-hp., 440-volt motor.

Raw and Finish Grind Mill Building

Total connected load, 4,709 hp.

Two Allis-Chalmers compeb mills for raw materials, 40 ft. long and operated at 24 r.p.m., each driven by 800-hp., 2,200-volt, 180-r.p.m. Allis-Chalmers synchronous motor with 72-in. Cutler-Hammer magnetic clutch and Falk flexible coupling. Each mill is fed by two Schaffer poidometers from feed hoppers, both poidometers being driven by a 3-hp., 440-volt variable-speed motor.

Slurry from raw mills flows into trough in which there is air agitation. Flows from this through pipe to two 4-in. Wilfley pumps, each driven by 30-hp., 440-volt, 1,200-r.p.m. motor, which pump slurry to correcting basins.

Water used for making slurry taken from near-by creek, from which it is pumped by two 300-g.p.m. Gould triplex pumps, each driven by 20-hp., 440-volt motor, to central storage tank.

In same building are two finish mills similar to raw mills except that they operate at 19.9 r.p.m. instead of 24 r.p.m. Cement clinker and gypsum weighed by four Schaffer poidometers, driven as above, and feed into finish mills through two screw conveyors, each driven by a 5-hp., 440-volt motor.

One 5-hp., 440-volt, 720-r.p.m. cement screw conveyor.

One 5-hp., 440-volt, 720-r.p.m. cement screen.

Two Fuller-Kinyon cement pumps, each driven by 75-hp., 2,200-volt, 900-r.p.m. motor pump, finished cement to silos.

There are three electric chain hoists (one for each chamber) for loading pebbles into the four mills. Each hoist is driven by 5-hp., 440-volt motor.

In this building are also located:

Main switchboard for entire plant.

Kiln draft is controlled by adjustable-speed fans. As the fans are not designed to withstand a temperature of more than 700 deg. F., a fresh air damper was installed in the smoke chamber to admit air to lower the gas temperature whenever this was necessary. An entirely automatic control was designed for this purpose consisting of thermometers actuating electric contacts when the temperatures of the gases attained certain upper and lower limits. These contacts in turn energize relays acting on a solenoid-controlled three-way valve admitting water to a hydraulic piston, which in turn operates the damper. Signal lights on the control board at the burner's platform indicate the proper functioning of this device.

The numerous motors and instruments entering into the control of the kilns and the relatively great distances between the burner's platform and the various apparatus made it desirable to use remote control for all motors in the kiln house, with the control switchboard located on the burner's platform. On this board are placed the control of the coal blower motors, coal screw motors, kiln motors, revolution counters for kilns, induced draft fan motors, indicator showing rate of slurry feed, indicator showing draft at burning zone, etc. As adjustable speed is one of the desired features in the kiln house, practically all motors are direct-current energized by the motor-generator sets in the mill building. Interlock relays tying the kiln motor and slurry feed motor together, as well as the motors driving the coal blower and coal screw, are provided as a safeguard.

Major Equipment, Phoenix Portland Cement Corporation's Plant (Continued)

"Norblo" filter type dust collector with four motors totaling 47 hp.

One Ingersoll-Rand 18x11x14-in. air compressor, driven by direct-connected 175-hp., 2,200-volt, 257-r.p.m. synchronous motor.

One Ingersoll-Rand 15x9½x12-in. air compressor, driven by direct-connected 125-hp., 2,200-volt, 277-r.p.m. synchronous motor.

Two 435-hp., 2,200-volt motor generator sets for direct-current motors in kiln house. One of these may be connected through clutch to a 300-hp. Stirling gasoline engine for supplying power to kiln house if main power source is interrupted.

Slurry Handling and Mixing

Total connected load, 196 hp.

Slurry from three correcting basins discharged by gravity to mixing basin. Three F. L. Smidth & Company agitators in correcting basins connected to common shaft driven by 30-hp., 440-volt, 720-r.p.m. motor. Similar equipment for mixing basin.

Slurry transferred to 200x25x21-ft. storage basin by Smidth air-lift system supplied by a 7x10-in. Ingersoll-Rand air compressor direct connected to 40-hp., 440-volt, 1,200-r.p.m. motor. Smidth traveling automatic agitator in storage basin driven by 5-hp., 440-volt motor, with agitators driven by 10-hp., 440-volt motor.

From storage basin slurry flows the sump, in which there is a horizontal type agitator driven by 15-hp., 440-volt, 720-r.p.m. motor. Pumped from here by either of two 4-in. Wilfley pumps driven by 30-hp., 440-volt, 1,200-r.p.m. motors to kiln feed tanks.

Two slurry kiln feeders of ferris wheel type, each driven by 3-hp., 230-volt, 650-r.p.m. to 1,200-r.p.m. direct-current motors.

Kiln House

Total connected load, 510 hp.

Two 343 ft. 9 in. kilns made by the Traylor Engineering & Manufacturing Company, each rotated by 100-hp., 230-volt, 450-r.p.m. to 1,000-r.p.m. direct-current motors.

Kiln draft controlled by four Buffalo Forge Company conoidal fans driven by 40-hp., 230-volt, 300-r.p.m. to 600-r.p.m. direct-current motors.

Three 440-volt, 720-r.p.m. motors, 5 hp., 10 hp. and 15 hp., drive three screws for collecting dust in kilns.

One 12-in. dust elevator, 59 ft. center to center, driven by 15-hp., 440-volt, 720-r.p.m. motor, takes dust to slurry feed.

"Skipulter" conveyor takes clinker from kiln to storage. This is driven by 15-hp., 440-volt, 720-r.p.m. motor.

Two pulverized coal feed screws for kilns, each driven by 5-hp., 230-volt, 600-r.p.m. to 1,800-r.p.m. direct-current motors.

Two air blower fans for pulverized coal feed, each driven by 40-hp., 230-volt, 900-r.p.m. to 1,750-r.p.m. direct-current motors.

Special switchboard at burner's platform, from which is controlled all equipment in kiln house.

Coal Mill

Total connected load, 333 hp.

From coal hopper under tracks coal is elevated to drier bins by Bartlett & Snow automatic skip hoist with a 60-cu.ft. bucket. Hoist driven by 7½/15-hp., two-winding, 600/1,200-r.p.m., 440-volt motor. Capacity, 40 tons per hour.

Fuller-Randolph vertical type driers, heat supplied by Riley-Jones stoker-fired furnace with 2-hp., 440-volt blower. Stoker driven by 3-hp., 440-volt motor.

Two 46--in. Fuller-Lehigh mills, driven by 100-hp., 2,200-volt motors. These mills fed by two 1½-hp., 230-volt, direct-current motors.

Two Buffalo fans, driven by 40-hp., 2,200-volt motors, take dust from these mills to 8-ft. cyclones above.

Pulverized coal from both mills goes through 6-in. Fuller-Kinyon pump, driven by 20-hp., 440-volt motor to coal hoppers at kilns.

Storage and Packing House

Total connected load, 362 hp.

Ten silos, 25 ft. inside diameter and 80 ft. high, arranged in two parallel lines. Space at ends closed by two silos, 16 ft. inside diameter. A space inside of all circular silos gives one large storage bin about 90 ft. long and 20 ft. wide. Total storage capacity is 160,000 bbl.

Cement removed from storage by three lines of screw conveyors in parallel, two passing under the two lines of 25-ft. silos and the third under center bin and 16-ft. silos. Each conveyor driven by 30-hp., 440-volt motor. These conveyors deliver cement to two shorter screw conveyors at right angles, each driven by a 10-hp., 440-volt motor. These shorter conveyors feed two inclosed chain elevators, 51 ft. center to center, each driven by 30-hp., 440-volt motor. Elevators discharge into bins of four Bates valve-bag packers, each operated by a 15-hp., 440-volt motor. Two loading belts from Bates packers (one belt to two packers), each driven by 5-hp., 440-volt motor.

In the 200x60-ft. baghouse is storage space, sorting belt 40 ft. long, driven by 5-hp., 440-volt motor, Nazareth bag cleaner, fed by 30-in. belt conveyor, driven by the same 20-hp., 440-volt motor that drives the bag cleaner.

Dust-collecting screw under bag cleaner discharges into 9-in. dust screw about 200 ft. long that runs through baghouse into screws that feed cement elevators. This is driven by 10-hp., 440-volt motor.

One "Norblo" dust collector with motors totaling 34 hp. placed on baghouse roof and a second one with motors totaling 44-hp. placed on roof above packing machines.

One Bates automatic bag-tying machine driven by 3-hp., 440-volt motor.

Short bag elevator driven by 5-hp., 440-volt motor raises bags from baghouse floor to packers.

Four ¼-hp. bag-sewing machines.

Auxiliary Building and Laboratory

A single one-story building 346 ft. long and 60 ft. wide contains in the following order: offices, drafting room, washrooms and showers (one for white and one for colored labor), electrical shop, oil storage, general storeroom, blacksmith's shop, machine shop, chemical laboratory and physical laboratory.

Miscellaneous Equipment

Total connected load, 163 hp.

Seven 3-hp. sump pumps.

Two 10-hp. car pullers.

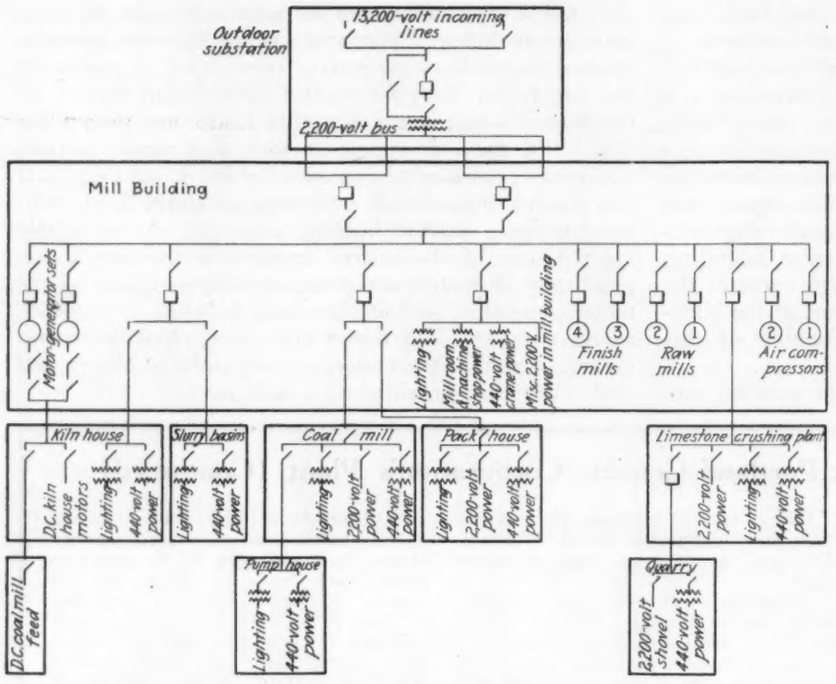
Thirteen individual drive machine shop tools totaling 52 hp.

One arc welder in machine shop rated at 7½ kw. or 10 hp.

One 15-kw. (20-hp.) current transformer for street-lighting system around plant.

Interior lighting throughout plant about 30 kw. or 40 hp.

Grand total connected load, 8,387½ hp. If the motor-generator sets for supplying direct current to the kiln house are deducted (direct-current motors are included in the grand total), the total connected load is 7,517½ hp.



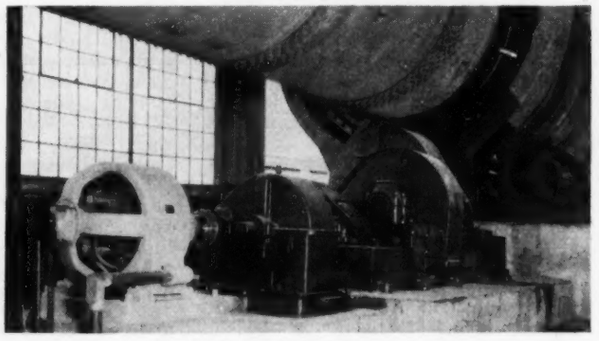
DISTRIBUTION SYSTEM EMPLOYED IN CEMENT PLANT WITH MAIN CONTROL IN MILL ROOM AND SEVEN LOCAL DISTRIBUTION CENTERS

Besides the standard equipment of the instruments and other devices forming the integral part of the control board, it was found necessary to develop special devices and signal systems to meet certain requirements. A special gear box and contact-making device for recording the revolutions of the kilns is one of these devices. The problem was to get an accurate contact-making device so arranged that it would be impossible to tamper with the recorder. A solution was found in a small gear box with triple worm drive with a total ratio exactly the same as that of the gearing between the kiln and kiln motor. The magneto for the speed indicator is also in the padlocked steel box containing the gears and contact-making drum switch. The shaft of the gear box is connected with the kiln motor by means of a flexible coupling.

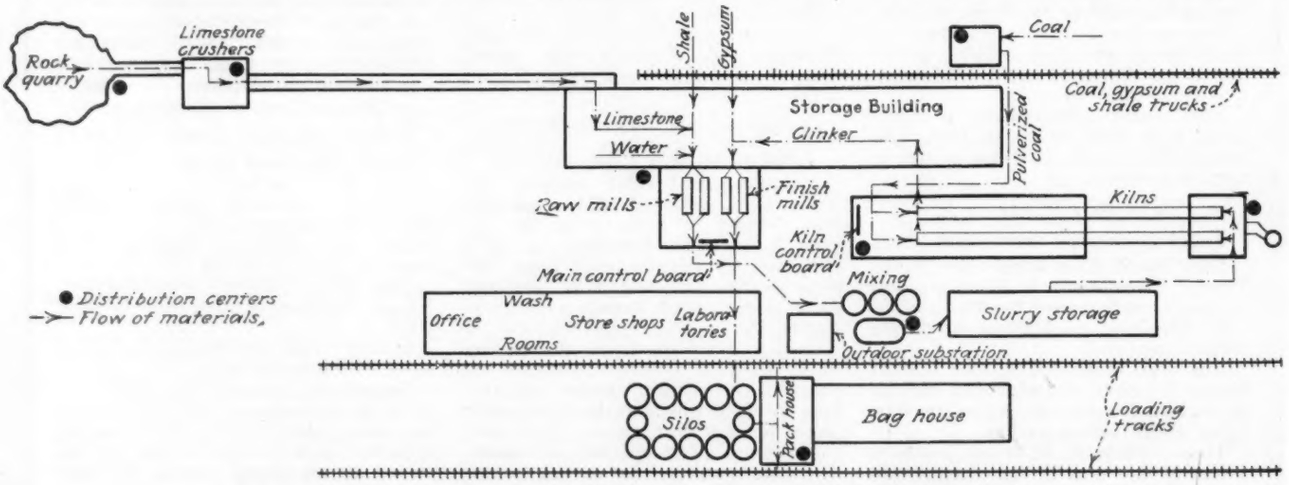
A feature not found in many plants is the 200x25x 21-ft. slurry storage basin. As it contains the material for from three to four days' milling, it can be seen that any day's variation will be divided by a considerable factor when the slurry is added to the contents of the big tank. As the slurry is already corrected in the mixing basin before being pumped to the storage basin, the contents of the latter are bound to be remarkably uniform in composition. A traveling agitator is used in this basin consisting of a frame on wheels which runs back and forth on rails on the edges of the tank. As the frame travels, agitating paddles are revolved which thoroughly mix the contents. The action of this traveling agitator is entirely automatic.

2,200-Volt Motors Used Extensively

All motors 40 hp. and above are operated at 2,200 volts with the exception of the crane motors in the storage building, which are 440 volts, as are all alternating-current motors below 40 hp. The 2,200-volt motors are started through automatic push-button compensators with the exception of the four mill motors, two air compressors and two motor-generator sets. The mill motors are started with switchboard-type compensators. The magnetic clutch between mill motor and mill is operated from a push-button control on the miller's platform or switch on the main switchboard through an automatic rheostat. The air compressors and motor-generator sets are thrown directly across the line.



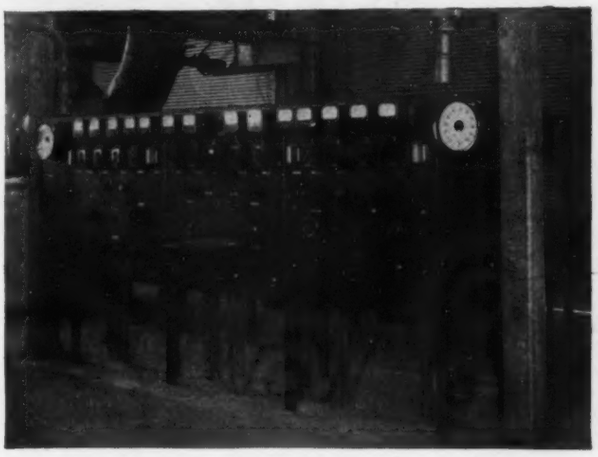
DIRECT-CURRENT MOTOR AND GEAR TRAIN DRIVES 344-FT. KILN



GENERAL LAYOUT OF PHOENIX CEMENT PLANT IN BIRMINGHAM, SHOWING FLOW OF MATERIAL THROUGH PLANT AND ELECTRIC DISTRIBUTION CENTERS

All 440-volt motors 20 hp. and below are remotely controlled by use of magnetic switches that throw motors directly across the line. On 440-volt motors 25 hp. and above hand compensators are used.

Adequate interior illumination of the various buildings is obtained by means of 200-watt and 400-watt one-piece steel reflectors with the exception of the auxiliary building, where composite glass refractors are used. A street-lighting system with 41 standards operated from



KILN CONTROL BOARD, FROM WHICH THE FEED AND EVERY OPERATION CONNECTED WITH THE KILNS MAY BE CONTROLLED

a 15-kw. constant-current transformer gives the plant a most pleasing effect at night. These lights are mounted on concrete standards staggered on 50-ft. centers with 12 ft. 6 in. light center. Translucent glass fixtures with 400 candlepower lamps are used.

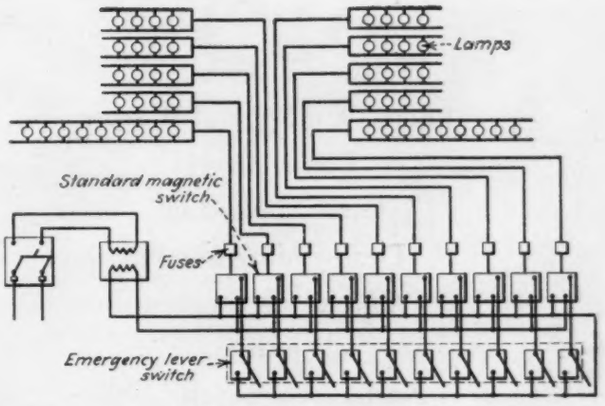
The cement made in this plant is of excellent quality and has rather unusual quick-hardening properties, attaining a hardness in three days that some cements require seven to 28 days to attain. This high early strength does not come from its chemical composition, because this does not vary much from the average portland cement. It comes principally from the greater attention in the burning in the very long kilns and from the grinding, which is finer than standard specifications require.

Copper Costs Reduced in Mill Lighting

By Davis H. Tuck
Holophane Company, Inc.

UNNECESSARY investments in copper wiring for the lighting equipment of large industrial buildings, such as steel mills, may be avoided by the use of a plan similar to that illustrated. Where large lamps must be hung high above cranes and, due to the length of the building, heavy copper must be used to carry the current resulting from the installation of many 120-volt high-wattage lamps a practical method of saving copper and avoiding the inconvenience of large safety switches for the lighting circuit is to apply remote control if undue voltage drop is to be avoided.

This method of distribution requires that the primary voltage of 440 to 1,100 volts be brought into the building to a fused safety switch and carried from there to a transformer arranged for 120 volts secondary distribution. The lighting circuits are distributed through con-



CONTACTORS AND REMOTE CONTROL SWITCHES USED FOR HIGH-VOLTAGE LIGHTING DISTRIBUTION

tactors of the magnetic type and remote control switches. Each circuit is fused at a location convenient to the crane operator. Several transformers arranged at the proper location on the under side of the roof permit satisfactory illumination with relatively small quantities of copper.

Electric Tractors Speed Handling of Ship Cargoes

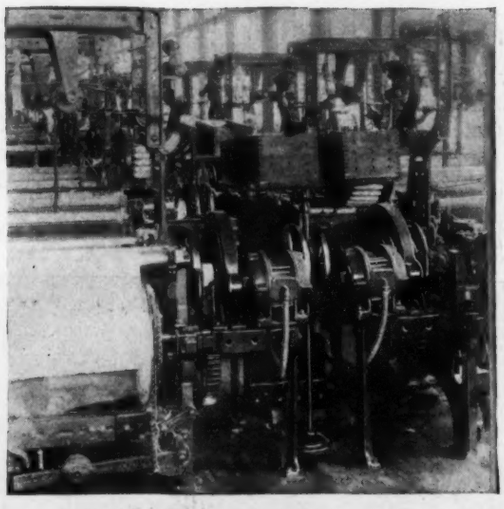
ELECTRIC trucks and tractors aid the New England Steamship Company in the handling and loading of large volumes of material at low cost. Between 130 and 140 carloads of freight from New England points arrive at the New York piers every day on the company's steamers and between 35 and 50 carloads are shipped on return trips. For seven years this company has used a system of trailers for handling miscellaneous packages of

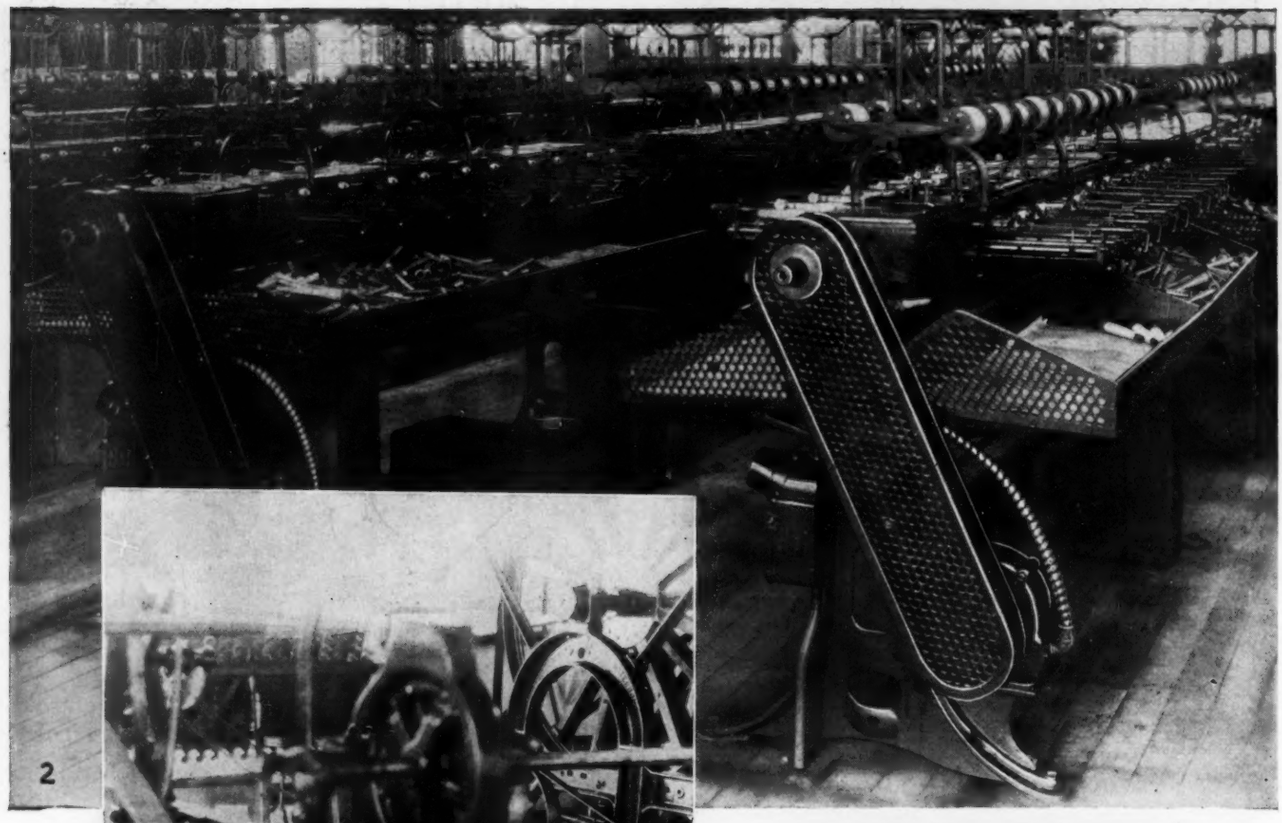
ELECTRIC TRACTOR-TRAILER PLAN AIDS IN COASTWISE SHIPPING

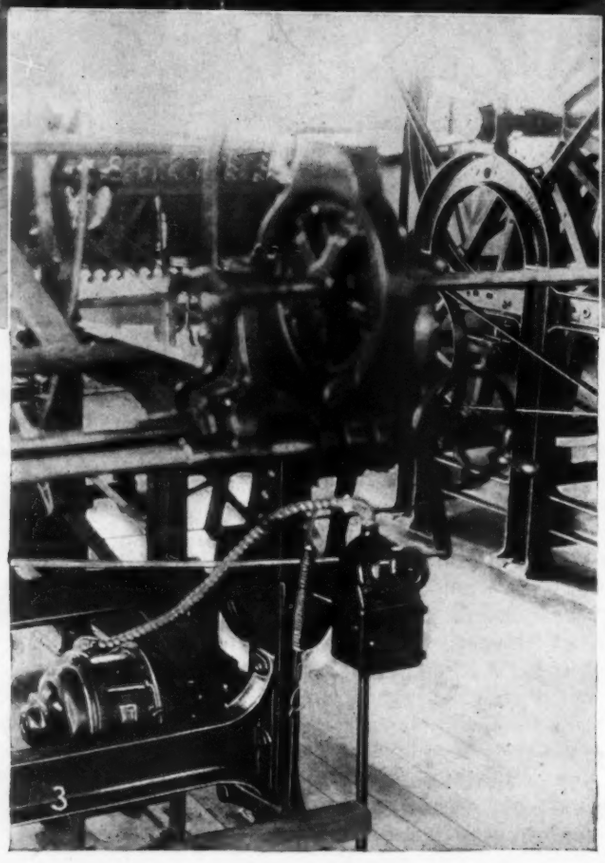
freight of all sizes, shapes and descriptions that previously had to pass through many pairs of hands at great expense of time and labor. These trailers are loaded, hauled through the pier and stored in the cargo space of the ship. Several trailers may be attached to one motive unit.

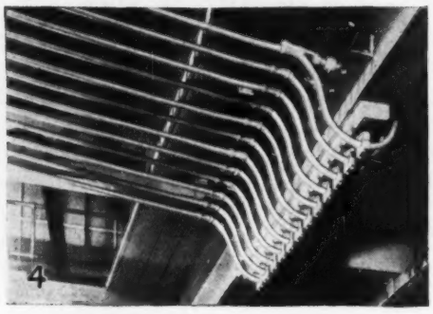
Upon arrival at the port of destination the trailers are quickly drawn out of the ship and off the pier by electric tractors and when unloaded receive new allotments of freight and return to the ship. More than 1,000 of these dock trailers are in service and 30 industrial trucks and twenty electric tractors are used by the company in carrying out this plan for the rapid, economical handling of shipments. Electric industrial trucks have been utilized for this purpose for fifteen years and the success met with in their use led to the planning and installation of the tractor-trailer idea.

Loom, Winder and Warper Power Drives and Method of Dead-ending Feeders Which Are Employed in the Nashawena Textile Mill

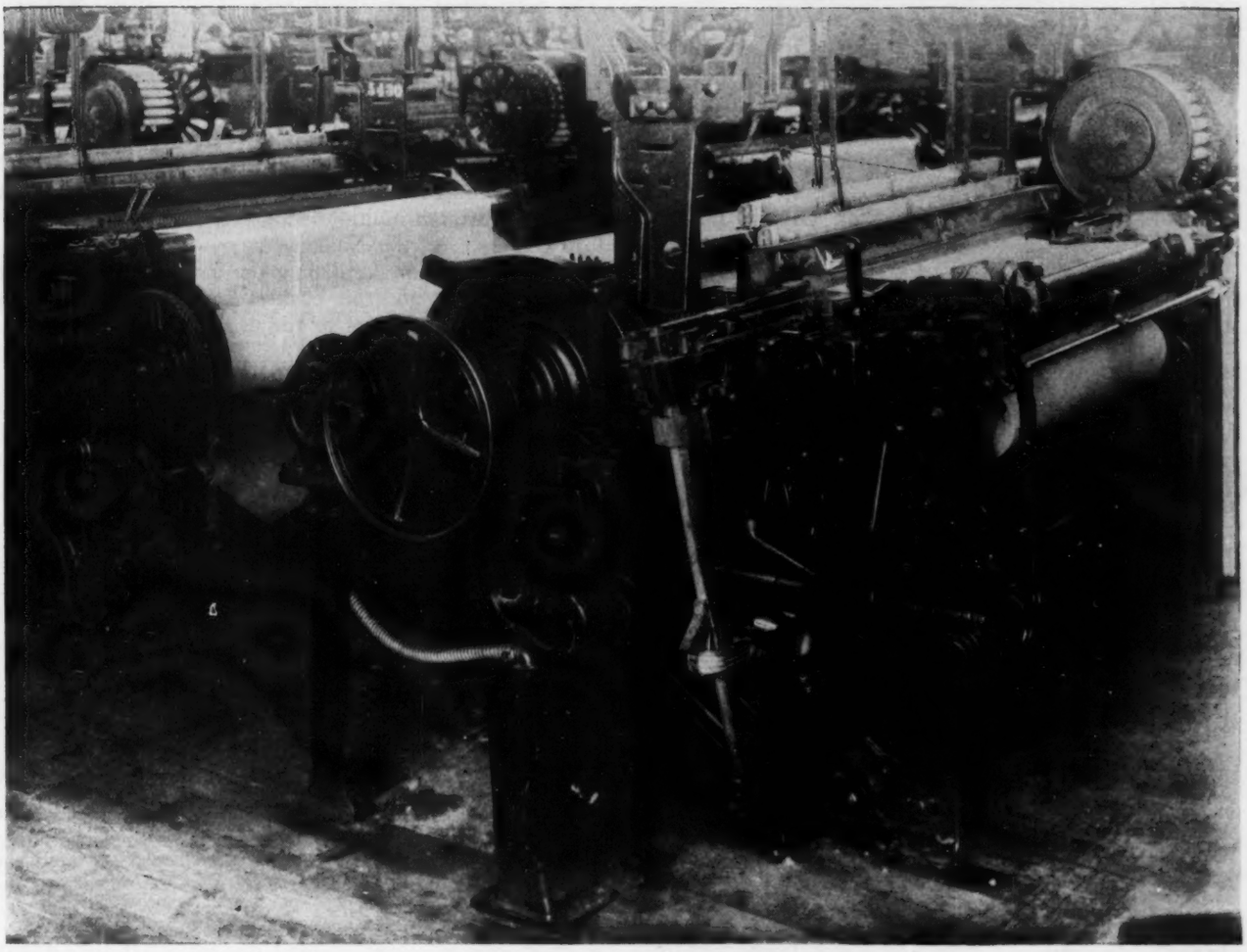








No. 1. Motor mounting for loom drive.
No. 2. Individually driven warpers.
No. 3. Universal winder drive.
No. 4. Anchoring power feeders by strain insulators.



INDIVIDUAL LOOM DRIVE AND CONTROL BOX

Nashawena Mills Has

5 Kva. Per Worker

By H. S. KNOWLTON
New England Editor ELECTRICAL WORLD

DIVERSIFIED production in the textile field imposes many problems for engineering consideration when a single establishment must meet widely varying market demands in a flexible and economical manner. Typical among the larger New England factory groups that have developed the capacity to adapt equipment to mass production through a wide range of output volume and stylings is the Nashawena Mills, at New Bedford, Mass. This house manufactures 400 differentiated products, including voiles, soisettes, twills, sateens, lawns, broadcloth, draperies, silks, rayon mixtures and shirtings. Electrical service has played an important part in its development. Through the courtesy of the management, the ELECTRICAL WORLD is enabled to present the following engineering data upon the more essential and advanced applications of electricity in this extensive plant.

These mills are divided into two groups, A and B, and when in normal operation employ about 2,800 persons. The products of the A mill range from all-cotton to all-silk goods, the warp ranges being from 18 to 100 and the filling ranges from 18 to 135. The B mill group is chiefly used in the production of plain goods, although it is partly equipped for the manufacture of fancy material. The yarn mill of the B establishment handles sizes ranging from 30 to 60. The weave shed works exclusively in cotton in this group. The two groups are separated about 1,000 ft. by land occupied by another organization. This separation, combined with a construction history embracing different periods of building erection, has

TABLE I—SUMMARY OF ELECTRICAL SERVICE AND ENERGY CONSUMPTION AT NASHAWENA MILLS IN NORMAL WEEK

These mills contain 275,400 spindles and 6,100 looms.

GROUP A*

Subdivision of Mill	No. of Motors	Total Hp.	Kw.-Hr. Used
Jack room	7	600	15,070
Card room No. 1	191	1,108	25,460
Card room No. 2	4	320	11,480
Ring spinning No. 1	106	2,001	50,600
Ring spinning No. 2	34	693	17,830
Ring spinning No. 3	41	703	18,730
Mule room	7	502	10,783
Twisting room	32	916	28,140
Weave room	1,916	2,316	50,100
Humidifiers	722	45	3,051
Machine shop	1	25	950
Totals	3,061	9,229	232,194
Lighting			10,600
Total power and lighting			242,794

GROUP B†

Picker room	20	230	2,970
Card room	9	540	11,610
Jack room	5	325	7,340
Ring spinning No. 1	25	725	13,240
Ring spinning No. 2	23	721	16,450
Ring spinning No. 3	20	700	19,070
Ring spinning No. 4	21	551	13,850
Dressing	13	171	11,970
Humidifiers and machine shop	162	361	6,380
Weave room	1,832	913	17,500
Totals	2,130	5,237	120,380
Lighting			1,036
Total power and lighting			121,416

COMBINED GROUPS

Number of motors	5,191
Horsepower of motors	14,466
Power, kw.-hr.	352,574
Lighting, kw.-hr.	11,636
Total used, kw.-hr.	364,210

* Floor areas: Weave room, 266,000 sq.ft.; spinning mill, 579,000; silk mill, 40,000; waste house, 19,200; picker room, 21,800 sq.ft.
† Floor areas: Weave shed, 127,000 sq.ft.; picker building, 150,000+; carding building, 71,000; spinning mill, 251,000 sq.ft.

brought about a decentralization of electrical energy supply to the mill groups. The A mill group is served by a 6,500-kw. steam-generating plant owned and operated by the Nashawena company and by the New Bedford Gas & Edison Light Company through a 3,750-kva. substation; the weaving mill in Group B by the Edison company through a 1,000-kva. substation; and the yarn mill, Group B, by the Edison system through a 3,000-kva. substation, making a total of approximately 14,250 kva. available, as the steam plant has a 25 per cent overload capacity above the nominal generator rating.

The total electrical service available per employee under full operating conditions is therefore about 5 kva. The total productive floor area in the mills is about 32 acres, of which 21 acres is in the A group and 11 in the B group, so the total available generating and substation capacity per acre of manufacturing space is approximately 445 kva.

Although there are no tie lines between Groups A and B, the Edison company serves the substation buses by two feeders in each instance, and continuity of operation is sought through multiple supply to the most important load centers. At the Nashawena power house a bus-tie switch provides for paralleling the locally generated and Edison services, and this enables the load to be divided between the two sources or the use of suplementary service as conditions require.

The total number of motors in operation in these mills is 5,191, exclusive of spares, and the connected motor horsepower of the establishment is 14,466. In a normal week's run the mills used 364,210 kw.-hr., of which 352,574 kw.-hr. was for power and 11,636 kw.-hr. for lighting service. No finishing processes are performed in these groups of mills. The accompanying table gives the number, rating and power consumption of motors in the various subdivisions of the two groups of mills for a typical week.

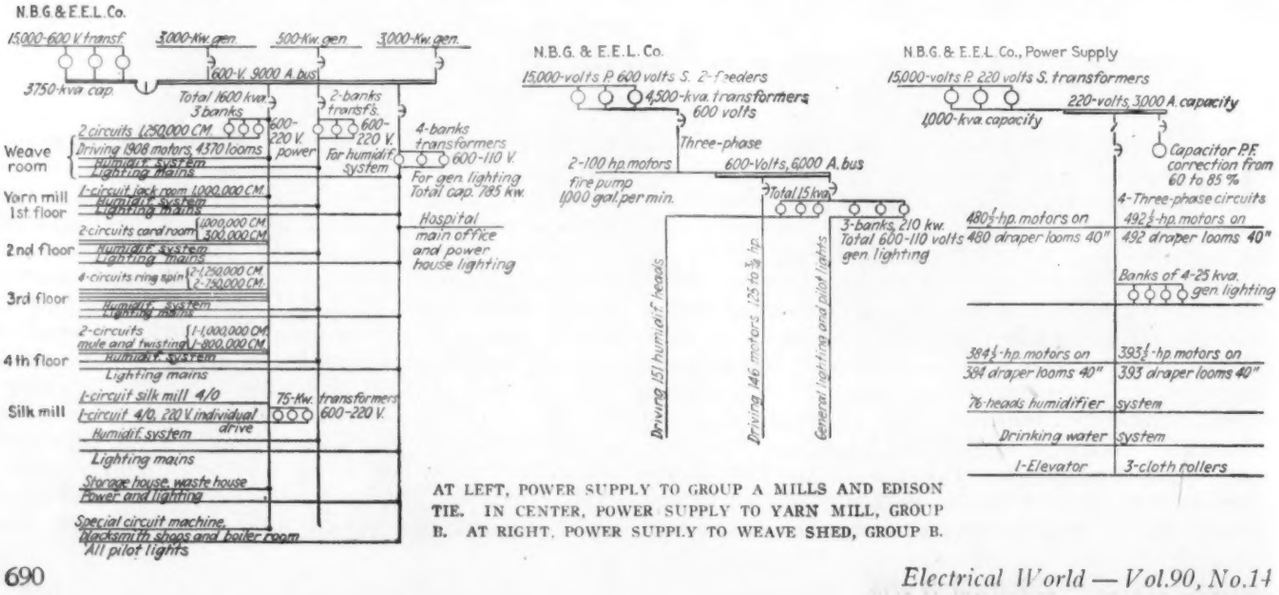
FEW SPARE MOTORS ARE STOCKED*

A			B		
No.	Hp. Each	Total Hp.	No.	Hp. Each	Total Hp.
4	20	80	16	30	480
5	¾	3¾	2	75	150
2	½	1	30	1/16	2
1	⅓	⅓	1	25	25
..	...	...	1	20	20
..	...	...	1	10	10
..	...	...	1	75	75
..	...	...	30	1/16	2
12	...	85	82	....	764

* Grand total spare motors both groups is 94, combined rating 849 hp. It should be noted that 60 of these motors are fractional horsepower units for humidifier service.

In common with many other textile plants, this establishment has found the electric motor drive sufficiently reliable to justify the carrying of a very small reserve in spare motor units. For the A group and B group the spare-motor stock is as shown above.

Tabulations are also given of the number of motors, their rating and the number and use of driven machines

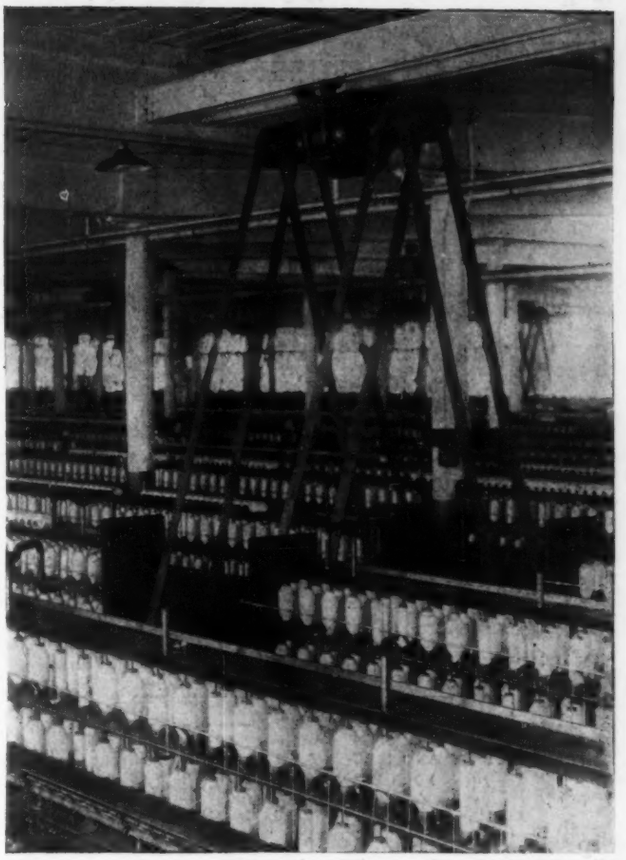

N.B.G & E.E.L. Co.
15,000-600 V. transf.
3000-Kw. gen.
500-Kw. gen.
3,000-Kw. gen.
600-V. 9000 A. bus
3750-kva. cap.
Total 1600 kva. 3 banks
2-banks transfs.
600-220 V. power
600-220 V. For humidif. system
4-banks transformers 600-110 V. For gen. lighting. Total cap. 785 kw.
Hospital main office and power house lighting
Weave room
2 circuits 1,250,000 CM.
Driving 1908 motors, 4370 looms
Humidif. system
Lighting mains
Yarn mill 1st floor
1-circuit jack room 1,000,000 CM.
Humidif. system
Lighting mains
2nd floor
2 circuits card room 1,000,000 CM. 500,000 CM.
Humidif. system
Lighting mains
3rd floor
4-circuits ring spin 2-1,250,000 CM. 2-750,000 CM.
Humidif. system
Lighting mains
4th floor
2-circuits mule and twisting 1-1,000,000 CM. 1-800,000 CM.
Humidif. system
Lighting mains
Silk mill
1-circuit silk mill 4/0
1-circuit 4/0, 220 V. individual drive
75-Kw. transformers 600-220 V.
Humidif. system
Lighting mains
Storage house, waste house
Power and lighting
Special circuit machine
Blacksmith shops and boiler room
All pilot lights
N.B.G. & E.E.L. Co.
15,000-volts P. 600 volts S. 2-Feeders
4,500-kva. transformers 600 volts
Three-phase
600-Volts, 6,000 A. bus
2-100 hp. motors fire pump 1000 gal. per min.
Total 15 kva.
3-banks, 210 kw. Total 600-110 volts gen. lighting
Driving 151 humidif. heads
Driving 146 motors, 1/25 to ¾ hp.
General lighting and pilot lights
N.B.G. & E.E.L. Co., Power Supply
15,000-volts P. 220 volts S. transformers
4,000-kva. capacity
220-volts, 3,000 A. capacity
Capacitor P.F. correction from 60 to 85 %
4-Three-phase circuits
480-hp. motors on 480 draper looms 40"
492½-hp. motors on 492 draper looms 40"
Banks of 4-25 kva. gen. lighting
384½-hp. motors on 384 draper looms 40"
393½-hp. motors on 393 draper looms 40"
76-heads humidifier system
Drinking water system
1-Elevator
3-cloth rollers

AT LEFT, POWER SUPPLY TO GROUP A MILLS AND EDISON TIE. IN CENTER, POWER SUPPLY TO YARN MILL, GROUP B. AT RIGHT, POWER SUPPLY TO WEAVE SHED, GROUP B.

for all major subdivisions of these two groups of mills. From these it will be seen that extensive applications of both group and individual motor drives are regularly utilized. In the earlier days of these mills, group driving was widespread and for many services it has remained thoroughly satisfactory. On the other hand,

TABLE II—MOTOR DRIVE DATA FOR "A" GROUP OF MILLS

No. of Motors	Hp. Rating Each	No. of Machines	Machinery Driven
			JACK ROOM
2	200	34	Jack frames, 200 spindles each; motors, 514 r.p.m.
1	100	60	Spoolers and 13 slashers; motor, 450 r.p.m.
1	60	54	Warpers and 6 doublers; motor 720 r.p.m.
2	15	2	Two 1-ton elevators
1	10	1	One 1-ton elevator
			CARD ROOM NO. 1
3	75	66	Second intermediates (speeders), 102 spindles per frame
2	125	184	Combers, 92 drawing frames, 28 first intermediates, 14 slubbers (160 spindles per intermediate)
1	50	28	Ribbon lappers (Whitin)
1	25	24	Sliver lappers (Whitin)
1	125	120	Cards (Whitin)
2	25	.....	Cotton condensers top floor picker building
6	15	6	Double openers, second floor picker building
4	10	4	Single openers, second floor picker building
12	7½	12	Finisher pickers, second floor picker building
2	10	2	Bale breakers, first floor picker building
1	5	1	Silk mill humidifier pump, first floor, storehouse
1	50	56	Entire top floor silk mill (26 5B spinners, 36 spoolers)
1	3	1	Extractor
12	1½	12	Silk warpers (Billington)
1	7½	1	Selvage spooler, silk mill
112	¼	112	Universal winders, silk mill
1	2	1	Drinking fountain, silk mill
1	1	1	Drinking fountain pump, silk mill
2	10	2	Elevators No. 7 and No. 8, 1-ton capacity each
25	¼	25	Universal winders, dressing room
			CARD ROOM NO. 2
2	125	248	Cards (Whitin)
1	50	31	Cards (Whitin)
1	20	12	Long chain beamers
			RING-SPINNING ROOM NO. 1
100	20	400	Ring spinning frames, 240 spindles each
6	⅓₀	6	Sweeping machines
			RING-SPINNING ROOM NO. 2
30	20	120	Ring spinning frames, 240 spindles each
1	3	1	Battery charging motor-generator set
1	40	1	Humidifying system pump
1	50	1	Air compressor
1	¼	1	Yarn testing machine
			RING-SPINNING ROOM NO. 3
30	20	120	Ring spinning frames, 240 spindles per frame
10	10	20	Ring spinning frames, 240 spindles per frame
1	3	3	Bobbin reamers
			MULE ROOM
5	100	25	Pairs of mules, 1,800 spindles per pair
2	1	2	Toilet fans
			TWISTING ROOM
30	30	120	Ring twisting frames, 240 spindles each
1	15	1	Elevator, 1-ton capacity
1	1	1	Toilet fan
			WEAVE ROOM
3	200	1,809	Looms (629 36-in.; 736 40-in.; 138 46-in.; 306 48-in.); motors 425 r.p.m.
2	100	529	Looms (169 36-in.; 252 40-in.; 108 46-in.); motors 720 r.p.m.
1	75	150	Looms (150 36-in.)
838	½	838	Looms (458 46-in.; 252 62-in.; 128 66-in.); motors, 1,200 r.p.m.
1,044	¼	1,044	Looms (1,044 40-in.); motors, 1,800 r.p.m.
1	½	1	Sample loom
1	40	1	Humidifier pump; motors, 950 r.p.m.
1	40	1	Humidifier pump; motors, 950 r.p.m.
1	10	.....	Bobbin cleaners; motors, 1,200 r.p.m.
1	25	.....	Baling, shearing, trimming and calendar machines; motors, 1,800 r.p.m.
1	15	.....	Folding machines, cloth room, motors, 950 r.p.m.
4	¼	.....	Individually driven cloth trimmers; motors, 1,800 r.p.m.
1	15	1	One 2-ton elevator; motors, 950 r.p.m.
1	10	1	One 1-ton elevator; motors, 850 r.p.m.
3	¼	3	Toilet fans
2	½	2	Toilet fans
1	7½	.....	Drawing-in machines
1	¼	.....	Warp knotting machine (direct-current, 110-volt)
			MISCELLANEOUS
1	25	.....	Machine shop and designing room
1	50	1	Salt water pump for lavatories
1	7½	1	Air pump, heating and ventilating system
2	10	2	Bale presses, waste house
1	10	1	Elevator, waste house
1	5	1	Battery-charging motor-generator set
1	3	1	Battery-charging motor-generator set
1	2	1	Air-circulating fan, subway
722	⅛	722	Humidifiers

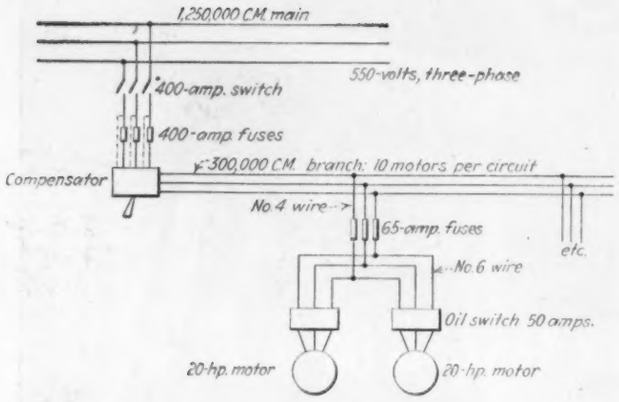


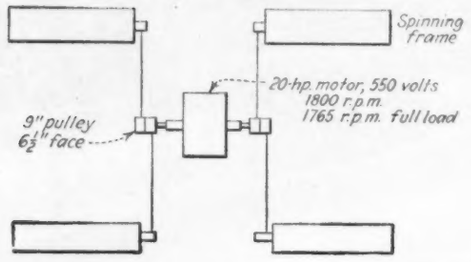
FOUR-FRAME DRIVE, MILL GROUP A

individual drive has been making steady progress during the development period of this plant, and thus examples of both types appear on a large scale.

In the older or A group of mill buildings, individual driving is utilized in the operation of double and single openers, finisher pickers, bale breakers, silk warpers, universal winders, nearly half of the looms and many auxiliary machines. Group driving is employed extensively for spinning machinery, and includes jack frames, spoolers, slashers, speeders, combers, drawing frames, slubbers, lappers, cards, mules and twisters. The well-known four-frame drive is used generally in running ring spinning frames and twisting frames in both groups of mills. As a rule a 20-hp. or a 35-hp., 550-volt, three-phase induction motor drives four ring frames with 240 spindles each. The motors are bolted to I-beams near the ceiling. In Group A the driving pulleys are carried in pairs at the outer ends of the motor shafts as illustrated. In Group B the motors are carried at one end of the shaft with a bearing at the other end and the pulleys between, ball bearings being utilized in this case. Each type of bearings has given excellent service and has advantages that have led the company to maintain both designs in this plant. The reliability of motors is again emphasized by the fact that in the two groups of mills only five 20-hp. spares are carried in stock, whereas the number of motors of this size in operation is 172.

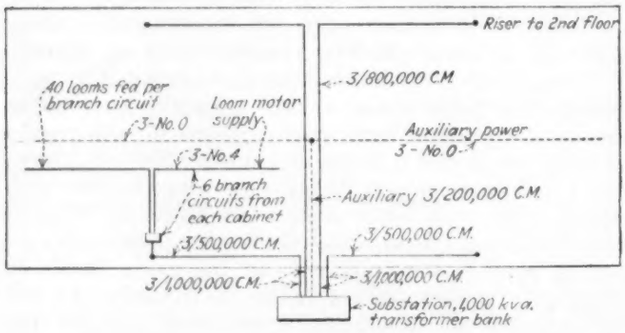
All recent loom drives are individual and the motors are mounted on brackets and geared to the looms as shown. The most modern installation, that of the weave shed in Group B, consists of 1,749 40-in. Draper looms installed in nearly equal numbers on two floors. Each of these looms is gear-driven by a ½-hp., 220-volt, three-phase General Electric induction motor controlled by a





POWER SUPPLY AND BELT-AND-PULLEY ARRANGEMENT FOR FOUR-FRAME MOTOR DRIVE

snap switch mounted in a cutout box carried on a pedestal fastened to the floor. The motors are mounted at the ends of the looms in such a way that the motor end plates are brought close together, leaving alternate aisles between the looms free for the passage of employees. Each pair of motors (and therefore of looms) is served by one cutout box containing a pair of terminal cutout fuses (one in each of two legs) and a two-wire switch for each motor. Each box is fed by a single three-phase tap taken through the floor from a three-phase branch



PLAN OF POWER SUPPLY LINES TO WEAVE SHED, GROUP B MILLS

circuit carried below the ceiling or in pipe in the first floor. In the two groups of mills there are but seven spare motors of ½- and ¾-hp. rating, the total number of motors of these sizes in service being 3,632.

In Group B there are 83 35-hp. motors with inside mounted driving pulleys and SKF ball bearings for these outfits. In ten years only fifteen bearings were changed.

Records kept of motor repairs in Group A over a sixteen-year period in which 2,000 motors were initially installed and an average of 3,074 maintained show that the total expenditure for repairs was only $2,535.16.

Loom motors are provided with waste-packed bearings and are oiled semi-annually. Motors of 20-hp. rating and over used in group drives are oiled and cleaned weekly, screens being wiped as well.

The results of a test of twelve individual loom drives are given in the accompanying table. Each loom, a 40-in. Draper, was driven by a ½-hp. motor. In these drives the motor is started light and brought up to speed before the loom is thrown upon it. The motor runs continuously thereafter until switched off. It is interesting to note that in these tests the no-load motor wattage did not exceed 40 and that in all but two cases the input in horsepower was below the motor rating.

When the weave shed of the B group was built, it became necessary to provide for power factor improvement, and a 240-kva. capacitor was installed in the substation serving that section of the mills. The power

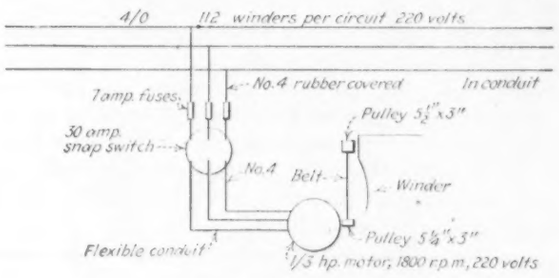
TABLE III—MOTOR DRIVE DATA FOR "B" GROUP OF MILLS

No. of Motors	Hp. Rating Each	No. of Machines	Machinery Driven
			PICKER ROOM
1	7½	1	Waste bale press
1	15	1	Elevator waste house
1	20	1	Bale breaker
6	15	6	Double openers
9	7½	9	Finisher pickers
1	15	1	Waste machine and conveyor from bale breaker
1	15	1	Conveyor
			CARD ROOM
4	75	239	Cards
2	75	124	Combers, 21 ribbon lappers
1	30	21	Sliver lappers
2	30	30	Drawing frames, 9 slubbers
			JACK ROOM
3	75	116	Jack frames (speeders)
2	50	40	Jacks, 20 first, 56 second intermediates
			RING SPINNING NO. 1
20	35	80	Ring spinning frames, 240 spindles per frame
1	15	1	Elevator
1	5	.....	Drinking water system spinning mill
1	3	.....	Drinking water system spinning mill
2	1	.....	Drinking water system spinning mill
			RING SPINNING NO. 2
20	35	80	Ring spinning frames, 240 spindles per frame
1	15	1	Elevator
1	5	1	Sample frame
1	1	1	Yarn-testing machine
			RING SPINNING NO. 3
20	35	80	Ring spinning frames, 240 spindles per frame
			RING SPINNING NO. 4
10	35	40	Ring spinning frames, 240 spindles per frame
10	20	20	Ring spinning frames, 240 spindles per frame
1	1	1	Bobbin-painting machine
			DRESSING ROOM
1	35	22	Spoolers
1	35	24	Warpers
1	35	4	Slashers
4	3	4	Slasher fans
1	2	1	Slasher drain pump
1	5	2	Size tanks
1	3	2	Bobbin-stripping machines
1	3	1	Yarn-conditioning machine
1	40	1	Air compressor pump
1	¾	1	Circulating pump, humidifier tank exhaust
			HUMIDIFIERS AND MACHINE SHOP
1	125	1	Humidifier water-circulating pump
1	15	1	Battery-charging outfit
1	25	.....	Machine shop equipment
1	5	1	Pump for lavatory service
6	30	12	Twister frames
			MISCELLANEOUS
144	¼	144	Humidifier heads
5	½	5	Humidifier heads
2	¾	2	Drawing-in machines in dressing room
1	¼	1	Emery wheel, electrical department
			WEAVE ROOM (INCLUDING BOTH FLOORS)
492	½	492	Looms, 40-in. draper (southwest sections)
480	½	480	Looms, 40-in. draper (northwest sections)
384	½	384	Looms, 40-in. draper (northeast sections)
393	½	393	Looms, 40-in. draper (southeast sections)
3	¾	3	Cloth inspection machines
1	¾	1	Cloth inspection machine
1	15	1	Elevator
1	2	1	Drinking water machines
1	¾	1	Drinking water pump
76	¼	76	Humidifier heads

factor was increased from a former figure of 63 per cent to the advantageous level of 83 per cent. A graphic record is maintained of the power factor variations at the weave shed substation, and during normal operating conditions this held above 80 per cent on a horizontal straight line basis for hours of each day.

In general, all motors below 2-hp. in rating are thrown directly upon the line in starting, larger units being started by compensators mounted on a wall or convenient column. Push-button stops are provided for motors driving card and picker room machinery.

The most modern lighting in these mills is in the weave shed of Group B. Here an intensity of 6 foot-candles was provided on a working plane about 4 ft. above the floor. The dominant units consist of 200-watt Type C lamps mounted in RLM reflectors 12 ft. above the floor, with spacings of 18, 26 and 15 ft. 6 in., as shown in the accompanying diagram. For aisle illumination beside outer walls 100-watt units are used. The reflectors are 15 in. in diameter and there are 238 200-

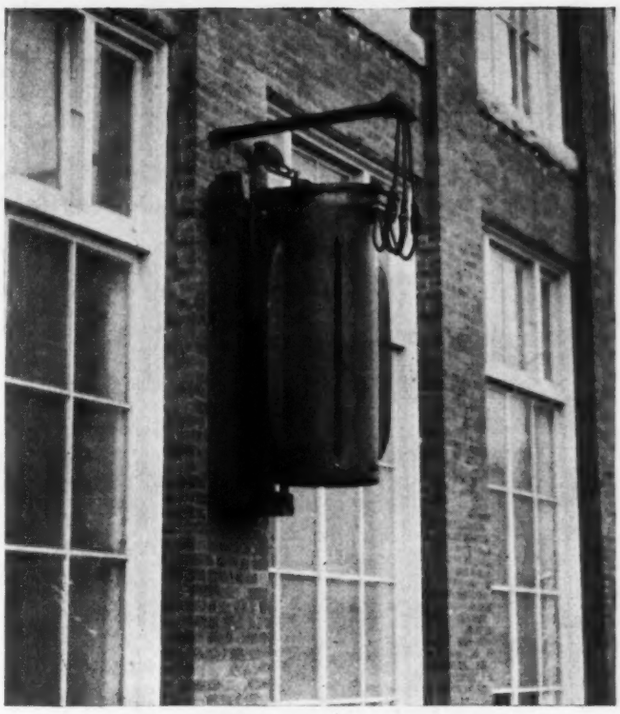


WIRING SCHEME UNIVERSAL WINDER DRIVE

watt units on the top floor and 241 on the ground floor, the weave shed being 524 ft. long by 121 ft. wide.

In the yarn mill of Group B lamps of 6,000 lumens are used, 91 per spinning floor. From 6 to 10 foot-candles are obtained at the frames, and the lamps are mounted 12 ft. 6 in. above the floor. In general, the units are located above the aisles between the frames. Space will not permit a résumé of the illumination in the older group of mills, A, but in general units have been disposed above aisles and with reflectors designed to avoid glare and concentrate light upon material in process at each important stage of production. This has required much experimental placing of lamps to suit the great variety of products manufactured and it has not been possible to preserve the same symmetry of unit location that was applied in the weave shed of the plain goods mill, Group B.

The general schemes of wiring these groups of mills are shown in the accompanying sketches. The most



25-KVA. MILL LIGHTING TRANSFORMER HUNG ON EXTERIOR WALL OF BUILDING

recent work of general interest was the wiring of the weave shed in Group B. From the substation oil switches feeders were run in steel conduit underground into a pit on the south side of the mill. From this point conduits run up to the ceiling of the first floor and from here slow-burning conductors were run to points in the vicinity of cabinets controlling branch circuits. From the ends of the slow-burning conduits varnished cambric cables were run in conduit down to cabinets on the first floor and up to cabinets on the second. All open wiring is of the cleat-supported type, and all feeders are anchored, using strain insulators and turnbuckles at each end.

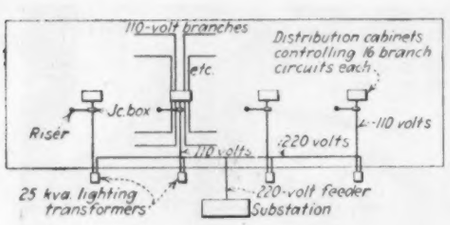
There are four power-control cabinets on each floor, each governing six branch circuits supplying a standard layout of 40 loom motors per circuit. The feeders are provided with 300-amp. fuses and each branch circuit with 50-amp. fuses. As stated, all this weave shed power service is at 220 volts, three-phase, this potential being used on motors in close proximity to employees, because it is considered safer than higher pressures.

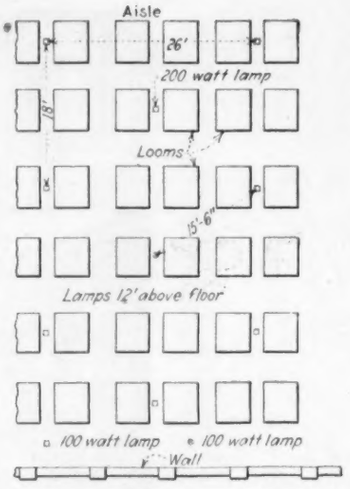
From each of the four cabinets on the first floor are run six branch circuits of No. 4 rubber-covered wires

TABLE IV—RESULTS OF TESTS ON LOOM MOTORS

Fabric widths were 37½ in. for a, b and c; 38½ in. for d, e and f; 40½ in. for g, h, i and j, and 42 in. for k and l.
The loom was in each case a Draper automatic, 40-in. Model K, gear-driven by a ¾-hp., 60-cycle, 220-volt, 1,800-r.p.m., three-phase induction motor. Air temperature, 25 deg. C.; motor lamination temperatures, 40 to 48.5 deg. C.

Loom	Picks P.M.	Gear Data	Average Watts	Maximum Watts	Minimum Watts	Watts No Load	Amperes	Volts	No. Harness	Duty	Fabric	Hp
a	146	15/176	463	505	437	38	1.92	200	10	Heavy	Collar	0.53
b	144.5	15/176	435	500	370	35	1.87	196	10	Heavy	Cloth	0.48
c	146	15/176	450	538	375	35	1.84	198	10	Heavy	Cloth	0.51
d	148	15/176	375	400	338	40	1.75	200	8	Medium	Sateen	0.44
e	147	15/176	390	425	363	40	1.92	200	8	Medium	Sateen	0.47
f	147	15/176	363	400	325	40	1.85	198	8	Medium	Sateen	0.40
g	148	15/176	288	313	263	35	1.48	198	5	Light	Sateen	0.34
h	148	15/176	288	300	263	43	1.43	197	5	Light	Sateen	0.34
i	148	15/176	300	325	275	38	1.56	197	5	Light	Sateen	0.38
j	156	16/176	288	325	275	40	....	198	5	Light	Sateen	0.34
k	158	16/176	305	313	300	38	....	202	2	Light	Lawn	0.39
l	158	16/176	290	300	280	40	....	...	2	Light	Lawn	0.35



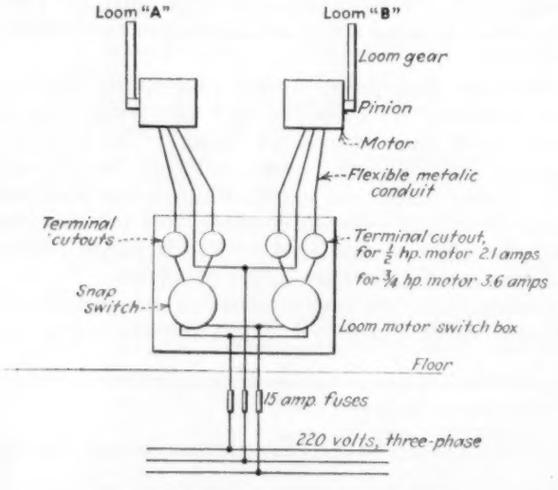


ABOVE, WEAVE SHED LIGHTING CIRCUIT PLAN, GROUP B. AT RIGHT, LAMP SPACING, TYPICAL SECTION OF WEAVE SHED

in 1¼-in. conduit down beneath the floor to the cutout boxes between each pair of looms. These boxes are of cast iron ¼-in. thick, and rubber gaskets are provided to make the joints watertight. No. 12 wire is used between the branch circuits, cutout boxes and loom motors, and from the control apparatus to the motors special flexible wires in ¾-in. flexible steel conduit are provided with suitable bushings at each end.

On the second floor, from each of the four cabinets are run six No. 4 branch circuits in conduit down to a point below the cabinet on the ceiling of the first floor. From this point No. 4 slow-burning wires are run open for each of the branch lines. These lines are tapped at each pair of looms and three No. 12 wires are run up through the floor in ¾-in. conduit into the pedestal and connected to the control apparatus. Connections to the loom motors are made as on the first floor.

An auxiliary power feeder is also provided for the weave shed. This runs to a fuse box below the center of the first floor ceiling and from this point traverses the



LOOM MOTOR WIRING SCHEME

entire length of the building. From this elevator motor and other auxiliary power service is taken.

A 220-volt main lighting feeder is run from the substation into the weave shed in the same manner as the power feeders, rising from the pit to the ceiling of the first floor in conduit and thence in open slow-burning construction to points just inside the south wall of the building opposite four 25-kva. lighting transformers on the outside factory wall. From these points rubber-covered wires are run through a fuse box to the transformer primaries. From the secondary terminals 110-volt connections are made by conduit lines through the wall and thence by slow-burning wire to four centrally located lighting cabinets on each floor. Solid neutral construction is used without fusing or switches. All these lighting cabinets are of the dead-front pattern, with 100-amp. fuses for the supply lines and push switches and 15-amp. fuses for each of the sixteen individual circuits controlled from each cabinet. Each branch circuit consists of two No. 12 slow-burning open wires with drops of flexible cord and six lamps per circuit. This arrangement forms the basis of the standard layout throughout this mill.

All conduit work in the wiring is grounded to water pipes, and special attention was paid to double grounding the conduits feeding the loom motors on the first floor. On the ceiling of the first floor beneath each of the six rows of cutout box pedestals on the second floor is run a No. 10 slow-burning wire lengthwise of the mill, connecting each pedestal to grounds at each end. All six wires are grounded at both ends.

High Points of a Power Company-Paper Mill Interchange Contract

Capacity of 22-kv. lines to mill, 2,500 kw.

Mill agrees to sell 2,500 kw. steam power to utility when needed and can be spared.

Mill guarantees to buy no definite amount of power.

Power company agrees to buy both steam and hydro surplus electricity from mill plants when useful on former's system.

No spare substation or generating capacity required of power company for this customer, whose service has supply rights in emergencies junior to other customers.

Power company is freed of obligation to pay increased steam plant capacity charge under which it could supply the mill by purchasing fuel-generated energy elsewhere.

Base rate per kilowatt-hour sold to mill, 1.6 cents, plus coal charge of 1 mill per dollar cost above $7 per gross ton at power company's auxiliary steam plant.

Rate paid for surplus electricity from mill plants fixed by resale value of such surplus energy by interconnection with other power companies, mill having option of supplying at this rate.

Rewires Factory for Better Lighting

Packard Motor Car Company revamps its lighting system. Use of newly developed square conduit gives unusual flexibility to wiring

By JAMES M. KETCH* and
L. R. BOGARDUS†

MOTOR ASSEMBLY LINE ILLUMINATION
(300 watt W.B., R.L.M., 8x10-ft. spacing, 12-ft. mounting height)

THE realization that time is becoming an increasingly important part of the productive dollar has spurred engineers of the Packard Motor Car Company to conduct an extensive investigation of methods of wiring to cut the time of changing circuits lower than that obtained with the ordinary open conduit systems. At the same time the aim has been to make the electrical layout for both light and power as flexible as possible. With the following methods it has been found not only that the system is extremely flexible but that it is also much lower in initial cost than open conduit methods previously employed.

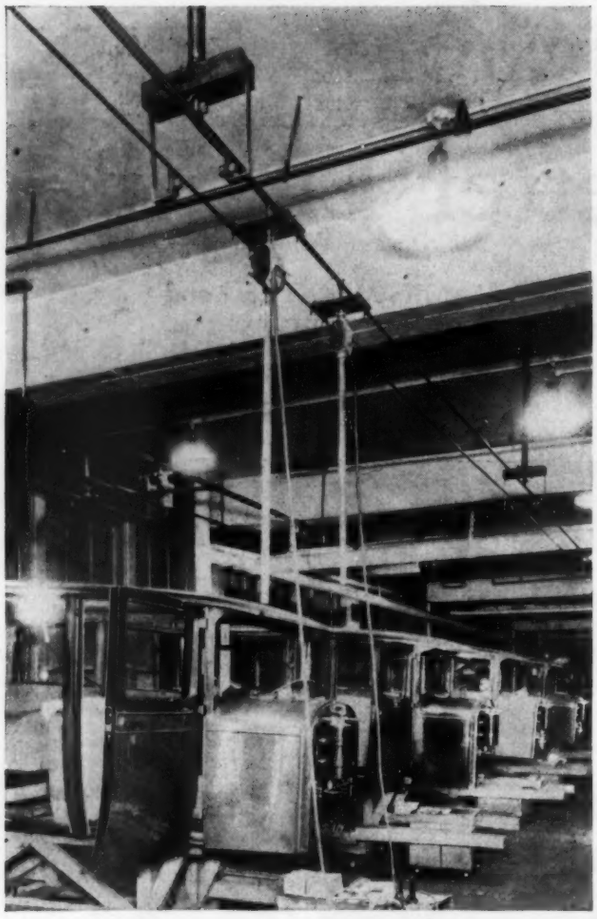
The big problem in revamping a wiring scheme was found in the feeder circuits that lead up to the individual branches, as this was the most expensive part of the circuit to tear down or change. With the development of a square duct by the company's engineers this costly item of revamping electrical circuits has been eliminated.

The original plan was to use a square sheet-metal duct 3x4 in. for the feeder circuits, and all of the feeder wires were carried in that box. Knockouts were punched for ½- to 1¼-in. conduit in the sides, top and bottom of the duct, so that a circuit could be very quickly inserted near the point desired. The open side of this duct was covered by a sheet-metal cover plate running the entire length of each section and held in place by screws similar to those used on an outlet box cover. With this cover plate off it was very easy to get at the feeder circuits and tap in a new power or light circuit with little loss of time. The ducts were ample in size and each distributing feeder was easy to get at. The result was that the cost of wiring and the time necessary for revamping or extending circuits were considerably reduced.

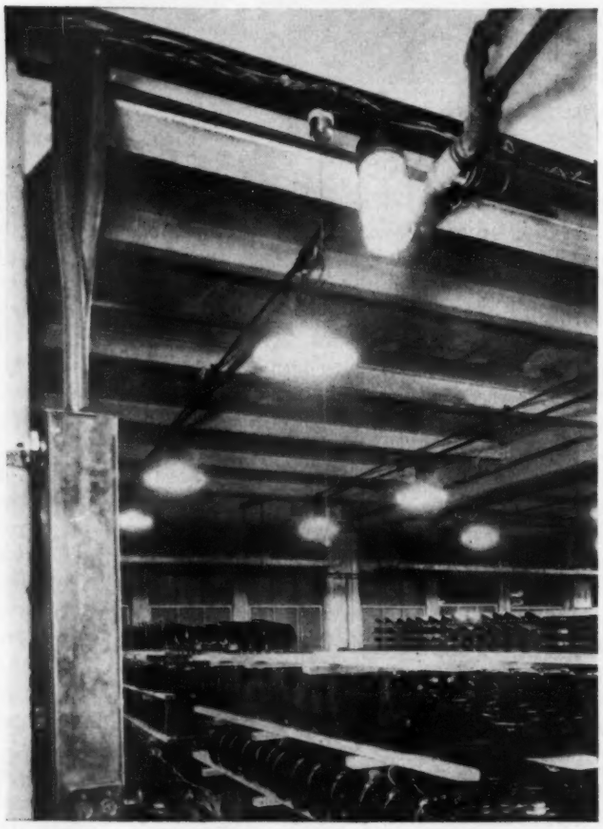
With recent developments in square duct methods a hinged cover has been made that eliminates again the time necessary for removing the screws of the cover plate. The cover is hinged at the top, is fitted with spring latches and swings upward and outward from the side of the duct. A power or light extension requires only that the cover plate be lifted and the knockout removed. It can then be tapped into a spare circuit and the conduit can be fastened. This is quite as simple as open wiring, and the safety is as great as would be found with complete conduit wiring methods.

This duct system seems particularly advantageous in plants where it is necessary to change the location of machines or even of whole departments frequently. Through the use of the wiring duct, when it does be-

*Illuminating engineer National Lamp Works.
†Electrical engineer Packard Motor Car Company.



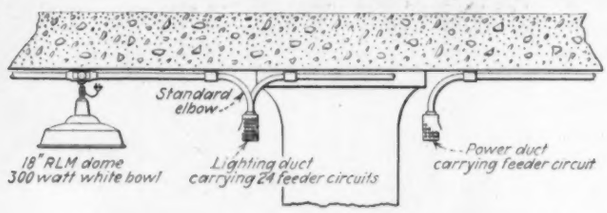
TROLLEY SYSTEM OF ENERGY SUPPLY USED ON BODY ASSEMBLY AND INTERIOR TRIM OF CAR



HOW DUCT IS LOCATED TO TAKE ADVANTAGE OF A SINGLE ELBOW IN REACHING CONDUIT

come necessary to change the location of a machine, all that is necessary is to disconnect the short piece of conduit from the trough, draw the wires back to the panel or into the trough and close up the hole in the trough with a knockout closer. When the machine is set in the new location, the duct serving that section is tapped near the machine, a short piece of conduit is attached and the new connection is made.

One of the standard building widths at the Packard Motor Car Company is 60 ft., or two bays of 30 ft. each, with the row of columns through the center. The present plan, which has been found most flexible, is to run two square-duct feeder circuits the entire length of the building, one on each side of the center columns. One side carries the power lines; the other carries the lighting circuits. Separate panel boxes for light and power are located on the columns in the center and are spaced according to the number of circuits and the load to be



SECTION OF TROUGH, SHOWING WIRING ARRANGEMENT

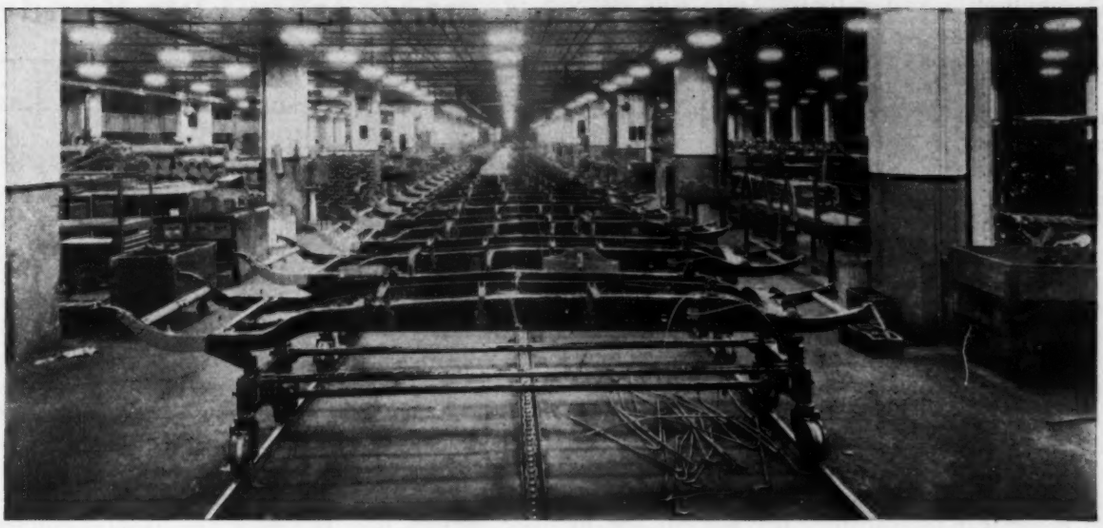
carried. Standard 24-circuit panels are used, and four circuits are ordinarily kept open for future requirements. Three light outlets per circuit is standard, and since only No. 12 wire is used, 500-watt lamps can be installed.

In order that these branch conduit circuits may be carried with the greatest ease, the ceilings of the concrete buildings are covered with anchor bolt channels running lengthwise of the building, so that cross-runs of power or light circuits can be very quickly bolted into position on the ceiling.

As far as possible standard lengths of threaded conduit are used in locating the light and power points.

Many tests have been run and many data have been gathered regarding the relation between foot-candles of illumination and production. Conditions have varied so on these tests that it is impossible as yet to lay down definite specifications, but in designing the lighting in the Packard plant it was felt that for operations involving either hand skill or a normal amount of visual effort an illumination in the order of 17 to 22 foot-candles should be furnished. Of course, for low-grade operations the illumination comes down to 10 or 12 foot-candles, and for those places where the visual requirements are higher, the illumination is accordingly of a higher order.

The average bay dimensions in the plants are 30x30 ft., and the ceiling heights are 12 to 13 ft. A spacing of lighting units of approximately 10x10 ft. was adopted. This put three rows of lights with three units (one panel circuit) in each row, or nine outlets in a bay. These units are made up on the floor and then carried to the ceiling. With the square-duct wiring scheme a single row of three outlets can be put up very quickly, because standard lengths of conduit are used, which, with the fitting, place the outlets 10 ft. 3 in. apart. Between the feeder duct and the first unit a half standard length of conduit is used. In addition to being able to use standard lengths of conduit, this has the advantage of throwing the units next to the outside walls a little closer than

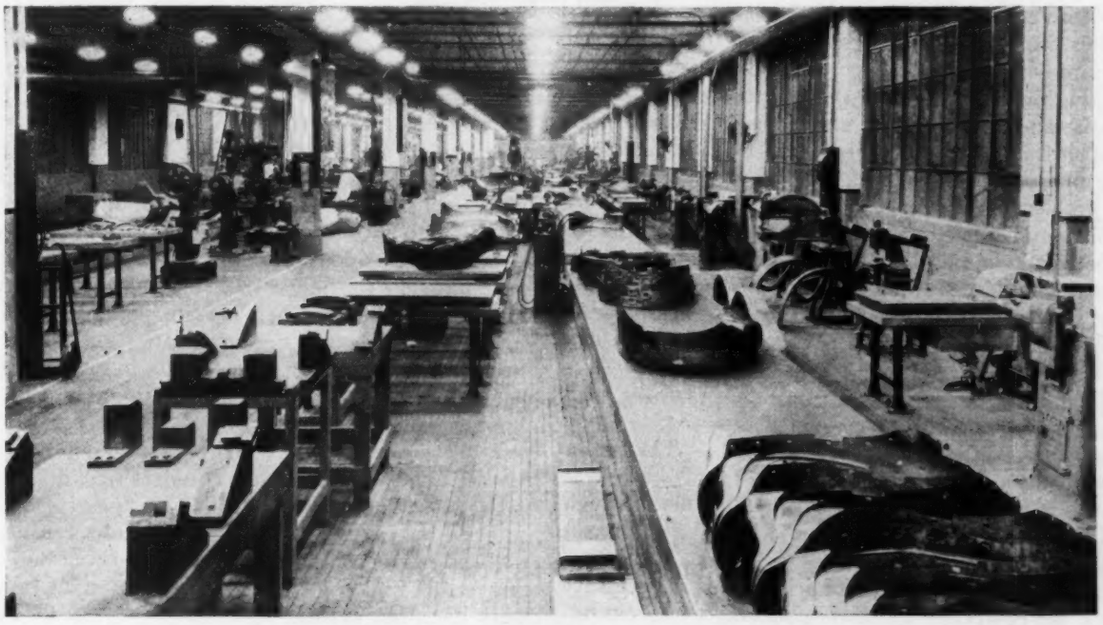


CHASSIS ASSEMBLY LINE ILLUMINATION
(300 watt C.L., R.L.M., 10x10-ft. spacing, 12-ft. mounting height)

would be obtained with the standard 10-ft. spacing. The outside rows fall about 4½ ft. from the wall and are close enough to the side wall so that bench or machine work can be carried on in the outside rows without additional bench or machine lighting. The feeder ducts are made up on the floor in 30-ft. lengths, then carried up ladders by three men, who suspend them from hangers. The line drawing shows how the duct is located to take advantage of a single elbow in reaching the horizontal conduit branches.

The standards of lighting are rapidly increasing, and whereas the plant may find that 15 to 20 foot-candles is sufficient for today's productive methods, tomorrow, with its high-pressure assembly lines and greater limits of accuracy, may require 30 foot-candles. In fact, some of the operations in the body-manufacturing departments today require from 50 to 75 foot-candles of well-directed and well-diffused illumination. With this possible future change in mind, the present circuits have been wired with No. 12 wire to allow for 500 watts per outlet, whereas the present standard is 300 watts per outlet.

The reflector adopted for most of the plant was the 18-in. standard RLM dome, which is designed for 300-, 400- or 500-watt lamps without any other change in equipment. Even in those departments where 200-watt lamps are considered sufficient for today because of the lesser visual requirements, the 300-watt RLM dome was installed and the 200-watt lamps are used for the present by inserting mogul-to-medium socket adapters in the reflectors. It happens that this adapter brings the 200-watt lamp very closely into the proper focal position and therefore little change is noticed except in the intensity of illumination. With this system, then, it is possible to obtain illumination values from 12 to 35 foot-candles with no change other than in the size of the



ILLUMINATION OF FENDER WELDING AND BUMPING DEPARTMENT
(300 watt W.B., R.L.M., 8x10-ft. spacing, 13-ft. mounting height)

lamp. This, in itself, is one of the very important items in maintaining the flexibility in the plant, it being uneconomical to burn 25 foot-candles on a job that requires only 12 and equally poor practice to demand that the workmen work with 12 foot-candles where 25 foot-candles are necessary.

A method of suspension has been adopted that adds one further refinement to the flexibility of the lighting system. This method of suspension makes it possible to vary the position of the lighting unit a short distance to either side of the actual electrical outlet itself. The plan has been popularly termed the "loop hickey and hook" method. A standard loop hickey is inserted in the top of the reflector in place of the rigid conduit. Through this loop hickey a short length of rubber-covered wire is drawn, terminating in a separable-plug cap.

The electrical outlet itself is fitted with a porcelain cover plate having the receptacle for the separable plug in it. In order that the cap may not fall out due to vibration, the porcelain cover plate is located on the side of the fitting. In some cases a piece of pipe strap is thrown over the conduit and clamped into position with a quarter-inch stove bolt and the unit suspended from it by means of an "S" hook. This makes it possible to slide the unit either side of the outlet as far as the cord will permit.

In cases where the units are suspended from a fairly high ceiling, the top of the reflector is fitted with the loop hickey and a short length of standard fixture chain with the wire threaded through the chain, terminating at the top in the separable cap.

This "loop hickey and hook" method of suspension has, in addition to flexibility, several other advantages: it is possible to wire the reflectors completely on the ground and snap them into place with a minimum of overhead work; the rigidity of the conduit is broken and thereby a lot of the vibration and shocks that would otherwise be transmitted to the lamp filament is absorbed; and there is maximum ease of maintenance. With this method of suspension, the plan is to mount a stepladder with a clean lamp and reflector complete to replace the dirty one. The dirty unit can then be cleaned on the ground, with a minimum amount of labor and time.

Another problem is to get good lighting inside a closed car body moving along on a conveyor line, for the men are working on all sides and on top of the body in fitting the upholstering. Heretofore extension cords have been in a hopeless tangle, especially since the body was in constant motion down the line.

This problem has been solved in the Packard plant by the "trolley-and-collector" method. Running lengthwise of the conveyor line and about 7 ft. above the floor is a three-wire grounded 120-volt trolley. This is made of standard trolley wire and supported by clips at intervals.

Sliding along this trolley is a collector to which can be attached extension lights to go inside the body or electric drills for fitting hardware. In either case the drill and the lamp fastened to the ceiling of the car ride along with the body, with no tangling of cords. The slider moves with little friction and is trouble-proof. The collector head is fitted with a short wooden handle by which it can be lifted off the trolley line when the workman moves back to his next job.

Since the wires are bare and fairly low, it is necessary that they be protected against accidental short circuit. One common plan is to locate a few 1,500-watt lamps in series with one side of the line.

Letters from Our Readers

Overhead Versus Underground Lines

To the Editor of the ELECTRICAL WORLD:

It is refreshing, and sometimes enlightening or amusing, to consider the thoughts and ideas which those not engaged in the public utility business sometimes have of that business. I refer to the letters of Gregory M. Dexter and S. R. Edward, published in the ELECTRICAL WORLD of Aug. 27 and Sept. 10 respectively. These men apparently do not understand certain of the problems that confront most utilities. It is unfortunate that some utilities probably do not realize that they are essentially public servants and as such must establish policies which will promote the interests of the general public. Most utilities, however, realize their obligations to the communities they serve and are earnestly striving to give the best service that economic and other conditions will permit.

The writers of the two letters referred to seem to think that it is inevitable that all electric lines in cities must finally be underground. By inference they both say, "Eventually—why not now?" The answer is not that cable manufacturers do not or cannot advertise directly to the public the advantages (if such there be) of placing wires underground. The answer lies rather in the fact that to place all wires underground in our cities would require much greater investment than we have now, and the increased maintenance and operating charges (including fixed charges) would result in material increases in electric service rates. The people in general do not want this, and it is not in their best interest that it should be done. Mr. Dexter spoke of the sales methods of automobile manufacturers. Even they have not been able to place Pierce-Arrow cars in the hands of all Americans. The reason is simple. Although most people might like to own Pierce-Arrows, they cannot afford to and so get along with Fords or no car at all. So, in the matter of overhead versus underground lines, most people do not have sufficient money to pay the difference in cost between overhead and underground.

Experience has shown, in general, that most property owners prefer underground lines; but when the revenue will not support the additional investment for underground lines and it is necessary, if such lines are installed, for them to pay the difference between the cost of the underground and overhead, their desire for underground construction disappears. Consequently, they get along with overhead lines in the vicinity of their property, just as people do with Fords when they do not have the money to buy more expensive cars. Cheap electricity, due in large measure to the use of overhead lines, has made the widespread use of electric service possible and is beginning to bring about a decentralization of industry which promises to be of inestimable value to our civilization.

The utilities are not, as stated by Mr. Dexter, "holding America back from becoming a better and more beautiful place in which to live." They are doing their part to remove drudgery from the shoulders of workmen everywhere and to lighten the burden of housewives not only in our city homes but more recently in our farm homes as well. Let's not check the good work being done by putting wires under ground. This is a thing which will work itself out in time.

G. G. POST,
Electrical Engineer.
Milwaukee Electric Railway & Light Company,
Milwaukee, Wis.

News of the Industry

Colorado River Dispute Still Rages

Various Plans for Division of Power Are Debated—Arizona Accepts Division of Water on Condition that Power Agreement Is Reached

REPORTS from the Denver conference on the Colorado River problem received from an optimistic source as the ELECTRICAL WORLD goes to press are to the effect that the delegates are near agreement on the division of power, which has been the chief stumbling block in their deliberations. A proposal that hydro-electric power generated at Boulder Dam be divided evenly between California, Nevada and Arizona has been accepted by Thomas Maddock of the Arizona delegation. Arizona had originally held that she should have 81 per cent of the power from Boulder Dam, the remaining 19 per cent to go to Nevada. California through her delegates had declared her willingness that 15 per cent of Boulder Dam power be allocated to Nevada and a like amount to Arizona, the remaining 70 per cent to be sold by the federal government in the open market with preferential rights to political subdivisions. This proposal is equivalent to the section written into the Swing-Johnson bill last winter at the instance of Senator Pittman and at that time acceptable to him.

The four upper basin states are said to be reluctant about entering any power controversy at this time which might embarrass them at a later date when the question of their right to power from the river is under consideration. The delegates showed considerable interest in a proposal made by United States Senator Copeland of New York. Speaking in San Francisco on Sept. 27, Senator Copeland recommended an amendment to the Swing-Johnson bill whereby California, Nevada and Arizona could control distribution of power generated at the dam and after reimbursing the government for the construction of the project would divide the power income of six or seven million dollars yearly between themselves.

Coming strongly into the situation through Imperial Valley Irrigation District representatives is a statement by them that California, if not properly treated at the conferences, may stand upon strictly legal rights and file a suit to establish its prior appropriation rights against later upper basin or Arizona appropriations and Denver's plan to appropriate water for its own use. All developments now under way would be handicapped seriously and future developments would be halted for at least a decade pending the outcome of California's contemplated action, according to some students of the question. It is significant that this same talk arose during the conference of the four governors of the upper basin states held late in 1925.

California won a fight for open sessions and also succeeded in having Senator Pittman's state-rights resolution on power deferred without a vote. Although all the other states are in favor of writing this principle into any legislation governing a federal project like the Boulder Dam, California remains fearful that she will be left at the mercy of Arizona and Nevada when it comes to the purchase of power. It is asserted by students of the political situation concerning the Colorado that Congress will probably recognize and adopt the state-rights principle, but will adopt some rule that will safeguard California in her purchase of power and prevent Arizona and Nevada from demanding excessive rates.

It is believed that California's opposition to the Pittman resolution is animated merely by a fear that it will mean the loss of federal aid in the building of a large storage and power dam. No hint has been made that her opposition comes from any intrigue with the power companies, and her stand for open discussions seems to bear out this conclusion.

The upper basin governors again turned to consideration of the water problem in the endeavor to work out a solution that would satisfy California's claim to a minimum of 4,600,000 acre-feet. Arizona has accepted the water allotted to her with the proviso that her rights to control electric power shall be recognized. Her spokesman, H. S. McClusky, said: "We believe that the division of water suggested is unfair to Arizona in that California has already exhausted her ability to take additional water from the river. Nevertheless, we accept it that the Colorado River problems may be solved. We must suggest, however, that no further sacrifice be asked of us. In the event these negotiations fail and this conference terminates without an agreement being reached, this acceptance is and shall be deemed to be withdrawn as fully and completely as if it had never been made."

The upper basin governors have agreed to the surrender of the unallocated waters in their states for the use of California and Arizona on a fifty-fifty basis, minus Mexico's portion.

Initiative petitions providing that any agreement, compact or treaty between Arizona and any other state or states relative to the Colorado River shall be submitted to a referendum vote of the people before such an agreement can become binding were placed in circulation in Phoenix, Ariz., this week.

U. G. I. and Philadelphia Electric

Exchange of Stock Recommended by Committees of Respective Boards of Directors and Approved by Boards—Stockholders and Commission Must Sanction Move

AN EXCHANGE of stock between the United Gas Improvement Company and the Philadelphia Electric Company, but with the retention of the corporate identity of each, was recommended to the shareholders by the two boards of directors at separate meetings held at Philadelphia on Wednesday, Sept. 28. The basis of the new relations, if the recommendations are accepted, is the exchange of Philadelphia Electric for United Gas Improvement stock, two shares of the former being exchanged for one share of the gas company; approval of this arrangement by holders of at least two-thirds of the stock of the Philadelphia Electric Company, and preservation of the corporate identity of Philadelphia Electric.

Identical formal statements were issued at the close of both meetings. After reviewing the action taken, they said:

"It is not intended that these companies will be merged. The Philadelphia Electric Company will preserve its corporate identity and separate organization, and, with the co-operation and expert assistance of the United Gas Improvement Company's organization, the electric industry in what may be termed the Philadelphia metropolitan district will be so developed as to render to the public the most efficient and economical service possible and at the same time result in advantages to the stockholders."

Arthur W. Thompson, president of the United Gas Improvement Company, refused to discuss the program further, but Walter H. Johnson, president of the Philadelphia Electric Company, issued a brief statement, in which he said:

"If 100 per cent of Philadelphia Electric stockholders shall take advantage of this proposition, it will mean that they will own 46 per cent of the stock of the U. G. I. It follows that they will share fully in the benefits that will flow from

the future prosperity of Philadelphia Electric. Of course, the stock of Philadelphia Electric as such will disappear when exchanged, but the organization will remain. It will be, in effect, the electric operating department of the U. G. I. in this field."

If holders of two-thirds of the stock of the Philadelphia Electric shall deposit their shares and U. G. I. stockholders shall agree to the projected new issue of stock, the entire plan must then be referred to the Pennsylvania Public Service Commission for its approval. The outstanding stock of the Philadelphia Electric amounts to nearly $93,000,000 and that of the U. G. I. to $106,500,000.

Color was lent last Saturday for the first time to the repeated newspaper stories of an approaching arrangement by which the United Gas Improvement Company would come into control of the Philadelphia Electric Company when announcement was made that committees of the two companies, composed of representatives of their respective boards of directors, had recommended a plan for the consolidation. The statement, signed by J. J. Sullivan, Jr., secretary of the committees follows:

"As secretary of the committees appointed respectively by the United Gas Improvement Company and the Philadelphia Electric Company to consider the desirability of a clear relationship between the two companies, I am authorized to state that as a result of these conferences the committees have unanimously agreed to recommend to their respective boards a plan which will be considered at their meetings next week providing for an exchange of stock on the basis of two shares of Philadelphia Electric stock, of the par value of $25 each, for one share of United Gas Improvement Company, of a par value of $50."

The committee of the United Gas Improvement Company was composed of Arthur W. Thompson, chairman; Samuel T. Bodine, Charles Day and Morris L. Clothier. The committee of the Philadelphia Electric Company consisted of J. R. McAllister, chairman; Charles E. Ingersoll, Horatio G. Lloyd, William A. Law and John T. Windrim.

Mr. Thompson is president and Mr. Bodine chairman of the board of the United Gas Improvement Company, and Mr. Day is head of Day & Zimmermann, Inc., which recently became a unit of that company. It will thus be seen that the chief executives of the U. G. I. represented it in its committee. This was not the case with the Philadelphia Electric Company, stock in which is very widely distributed. President Walter H. Johnson did not serve on the committee. Mr. McAllister, Mr. Ingersoll and Mr. Lloyd are bankers; Mr. Law is president of the Penn Mutual Life Insurance Company, and Mr. Windrim is an architect.

Immense Sums Involved

The consolidation of the two companies, if finally consummated, will be one of the largest public utility unions in history. The combined book assets of the two organizations exceed at the present time $375,000,000. The market value of the securities of these two companies, however, exceeds the half-billion mark. The United Gas Improvement has either financial control of or a financial interest in more than a hundred public utility companies of various kinds conservatively appraised at a billion dollars.

The Conowingo and interconnection enterprises recently undertaken by the Philadelphia Electric have been fully reported in the Electrical World and do not need recapitulation at this time. Nor is it necessary to repeat the newspaper embroidery concerning a prophesied further spread of the not yet consummated plan to take in New York and New England groups of utility companies.

Aldred Companies Not Seeking Access to Conowingo

Rumors that the Pennsylvania Water & Power Company was to become a party to the interconnection agreement adopted by the Philadelphia Electric, Public Service Electric & Gas and Pennsylvania Power & Light companies, thus bringing it and its allied Aldred company, the Consolidated Gas, Electric Light & Power of Baltimore, into a position to receive power from Conowingo and other outside sources, were promptly denied by Herbert A. Wagner, president of the Baltimore company. The rumors seem to have been based on the existence of a line energized by the Pennsylvania Water & Power which runs from Delta, Pa., to Conowingo to supply the energy necessary to the building of the dam. Mr. Wagner said:

"It is true that there is a line from Delta, Pa., to the Conowingo dam, but that is a small line and is not capable of transmitting large quantities of power. The belief that such a combination would result in economies is a fallacy, for the reason that the cost of building transmission lines connecting these companies is so great that it is cheaper to build steam plants."

An unconfirmed newspaper report credits the Pennsylvania Water & Power Company with the intention to build another hydro-electric plant on the Susquehanna River, north of the Holtwood plant, at an expense of $18,000,000 or more.

Commercial Standardization by Standards Bureau

Announcement has just been made at Washington of the appointment of R. M. Hudson to be assistant director of the Bureau of Standards in charge of commercial standardization. Up to the time the Electrical World went to press no details concerning the policy to be pursued or the relations that the new office would bear to existing standards-setting bodies had been given out.

Liversidge New President of Edison Association

Ferguson Makes Address—Report on the Mechanism of Cable Failure, Presented by C. F. Hirshfeld, an Outstanding Feature of Program

H. P. LIVERSIDGE, vice-president and general manager of the Philadelphia Electric Company, was elected president of the Association of Edison Illuminating Companies at its forty-third annual meeting, held at Colorado Springs, Col., on Tuesday, Wednesday and Thursday of this week. Following the usual custom of the Edison association, the meeting was held behind closed doors so as to insure free and frank discussions of operating performances and practices. The chief address of interest at the opening session was that of Samuel Ferguson, president of the Hartford (Conn.) Electric Light Company and retiring president of the association. Mr. Ferguson's address will be abstracted in an early issue of the Electrical World.

Tuesday evening's session was devoted to consideration of a study of the mechanism of cable failure made by a committee headed by C. F. Hirshfeld of the research department of the Detroit Edison Company. In this work the committee received great assistance from the University of Michigan and from the research laboratory of the Standard Oil Company of Indiana. The Detroit Edison Company looks with some concern at the size of the investment made annually in cable of questionable life and with still more concern at the hazard to service resulting from even more extensive installation of cable of uncertain worth and reliability. Besides, it objects seriously to the requirement of 50 per cent excess in number of cables to insure continuity of service. While not necessarily finding fault with the manufacturers, the company found it desirable to conduct a cable research in an attempt to find some solution to a vexing problem.

Mr. Hirshfeld and his co-workers accordingly set out to discover if possible the mechanism of the breakdown of high-voltage, impregnated, paper-insulated, lead-covered cable. They investigated what appeared to be fundamental mechanical, electrical and electrochemical or "radio-chemical" phenomena as offering a more promising field than study of the electrical behavior of the finished cable. Different methods of subjecting cable impregnating oils to electrical bombardment have been used. and it has been proved that these materials undergo rapid and extensive changes under such treatment. The final products are a wax which is virtually identical with that found in cable and a gas consisting almost entirely of hydrogen. It has been shown that the chemically stable oils now preferred for cable insulation are not nearly so desirable with respect to their properties under bombardment as other oils which have generally been considered less desirable for cable impregnation.

As a result of the tests made, incomplete as they are, the authors of the report arrived at the following tentative conclusions:

1. Every cable of the ordinary impregnated paper-insulated type contains reasonably large quantities of gas as installed.
2. Any bubble or layer of gas must be regarded as a dielectric in series with the composite dielectric on each side of it in a radial direction.
3. Under these conditions the distribution of potential drops is such as to put a comparatively high-potential gradient through the gas-filled space.
4. Under some conditions the voltage drop across the gas-filled space becomes great enough to cause cumulative ionization, thus giving a silent electric discharge through this space.
5. If the impregnating compound is such that it condenses (polymerizes with the evolution of gas) under electrical bombardment, and all compounds now in use appear to do so, then the silent electric discharge serves to generate more gas within the cable and presumably at or very near the walls of the existing cavity. There is thus developed a cumulative gas generation and this gas must build up a very high local pressure, or must spread laterally and radially through the cable in some way and thus open up new cavities for ionization.
6. No calculations made on the basis of any theory yet proposed can give the true voltage drop across such gas-filled spaces because of the rectifying action of the dielectric. This causes the addition of a direct-current voltage, of at present unknown magnitude, to the alternating-current peak in one direction.
7. Resin oil in admixture with petroleum products may and probably will lengthen the life of cable which is not required to operate at too high a temperature.
8. The beneficial action is probably due to the highly negative temperature resistance characteristic of resin oil, this material becoming sufficiently conducting to carry current around any gas pocket in which an electrical discharge, and consequently heating, has started, thus temporarily preventing further discharge.
9. The use of resin oil for this purpose places an undesirably low limit upon the load that can be carried by virtue of the rapidly rising dielectric loss with increasing temperature.
10. It would appear more rational to attempt a solution of the problem by one of the following methods: Discovery of an impregnating compound which will polymerize without condensation—that is, without liberation of gas—and which will still possess desirable properties in all other respects; discovery of some material which will serve to poison the polymerization which normally occurs under bombardment; discovery of some form of insulation which, if it requires impregnation, will have such characteristics that cumulative ionization is impossible even if gas is present.

A.E.R.A. Meets Again in Cleveland This Year

Following its procedure of last year, the annual convention of the American Electric Railway Association will again be held in Cleveland next week. A talk on leadership in the utility field, given by M. H. Aylesworth, president National Broadcasting Company; one on financial structure, by George E. Frazer, well-known accountant; an address on the contacts between the federal government and business, by Merle Thorpe, editor of the *Nation's Business*, and another on commission regulation, by William W. Potter, Attorney-General of Michigan, are scheduled for the general session to be held on Tuesday morning, Oct. 4, at the Cleveland Auditorium. George B. Cortelyou, chairman of the Joint Committee of National Utility Associations, will speak at the evening meeting on that day, as will B. C. Cobb, president Consumers Power Company. Among the subjects to be discussed by the power division of the Engineering Association, which meets on Tuesday afternoon, are radio interference, distribution layout for automatic substations, ventilation of substations, and mercury-arc power rectifiers. "Maintenance of a Large Overhead System" will be the subject of M. W. Cooke, Pittsburgh Railways, on Thursday afternoon.

Federal Ownership Again Opposed

Speakers at Great Lakes Division, N. E. L. A., Urge Greater Public Knowledge of Industry's Aims and Achievements—Domestic Load and Rural Development

SPEAKING before nearly one thousand members and guests of the Great Lakes Division of the National Electric Light Association at its seventh annual convention at French Lick, Ind., Sept. 22-24, President Thomas F. English paid tribute to the accomplishments of the utility industry in its development of interconnection, rural electrification and increased service to the public. He urged the importance of maintaining a united front to offset the misrepresentation and fiction now being so energetically propagated by government ownership forces throughout the country. To this end sound public relations are essential, and, like charity, they should begin at home.

NATIONAL PRESIDENT SANDS (RIGHT) AND DIVISION PRESIDENT ENGLISH

Following the same theme, J. F. Owens, chairman of the Public Relations National Section, declared that if the American public does not realize and appreciate the advantages it enjoys from private ownership and operation of the utilities, it is the utilities' own fault.

More general use of electric labor-saving devices in the home was advocated by Mrs. Edward Franklin White, vice-president of the General Federation of Women's Clubs, in a paper on "Development of the American Home." Mrs. White deplored the extremely low degree of electric appliance saturation in both rural and urban homes. When so many homes are wired for electricity, why are so few of the homes using labor-saving devices? Mrs. White asked. She suggested that it might be a question of salesmanship. Miss Ruth A. Wardell, head of the department of home economics, University of Illinois, enumerated four things about which the housewife must have more knowledge if she is to purchase and use the equipment intelligently—definite information on equipment, cost of installation, cost of operation, and function and performance. Miss Isabell Davie, secretary of the national women's committee, outlined its work.

On Thursday evening C. M. Ripley of the General Electric Company gave an illustrated lecture in which he compared working conditions in America with those in the rest of the world.

President H. T. Sands of the national association, speaking at the annual banquet, discussed the problem of a better public understanding of the industry and urged that every employee familiarize himself with fundamental facts in order to combat misinformation and destructive propaganda. A truly informed public, he maintained, will not permit the government to engage in such an unsound, uneconomic venture as federal development of water power. Paul S. Clapp, managing director N.E.L.A., warned against the hazard to the public of government ownership and operation of utilities and cited his personal observation of results of attempts in Russia to operate utilities under the soviet régime.

The second session was opened with an illustrated paper on "Tendencies in Home Lighting Practice," by A. L. Powell of the Edison Lamp Works. The paper criticised the present fashion of wall brackets and portable lamps and declared that a reasonable intensity level in general illumination is necessary in the home and that in the average installation a satisfactory general illumination may be obtained only by means of ceiling fixtures. The best type of unit for this use is the semi-indirect, now available in beautiful and distinctive designs. In the absence of O. R. Hogue, E. D. Tillson explained the Franklin specification fixture plan of the Electric Association of Chicago.

"Government Ownership" was the

subject of an address by Charles A. Eaton, a Representative from New Jersey, who has been a determined opponent in Congress of bills looking toward government ownership of electric power.

Among other definite statements made by E. W. Lehman of the University of Illinois, in his paper on the "Use of Electricity in Agriculture," were that one-sixth as many persons are required now to produce the food of the nation as were so engaged one hundred years ago, that it costs 30 to 60 cents a kilowatt-hour for electricity from a farm-unit plan, that modern tendency to large farms was the result of the use of power, that the farmer's use of rural service depends on what he has left to buy equipment with after he has helped to finance his line and that rate standardization of some kind is necessary in rural service. E. R. Meacham of the Wisconsin Power & Light Company described the methods used by that company in its pioneering and successful development of farm business.

Earl Whitehorne, commercial editor ELECTRICAL WORLD, sounded the call to arms in the Great Lakes Division with his "Message from the Sales Managers," which was received with enthusiasm.

In an address on the long-term budget, George E. Frazer, at the last session on Saturday, discussed the need for balancing existing capital charges and income with proposed capital investments and earnings projected in the future.

Discussing the effect of commission regulation upon the management of public utility enterprises, Henry R. Trumbauer, University of Wisconsin, cited and analyzed a wide variety of commission and court decisions in which it was shown that it is not the duty of public utility commissions to undertake the solution of managerial questions.

PRINCIPLES OF UTILITY OPERATION

Robert H. Dunn of the Michigan Public Utilities Commission, in an address, "Utilities Service," set down four salient principles in utility operation and management which he felt to be vital. They concerned good management, attention to complaints, sale of securities to customers, and use of the local press to make customers familiar with the reason and purpose of requests to the commission, before which body the utility should present all of its facts in complete but most concise form.

C. W. Horn, director of radio for the Westinghouse Electric & Manufacturing Company's broadcasting stations, described the work which utilities are doing to improve radio reception.

Successful Results Claimed for "Electric Plow"

Electrical experts from all parts of New York State, among them E. W. Pilgrim of the industrial engineering department of the General Electric Company, inspected the operation of Hamilton L. Roe's "electric plow" and "soil disintegrator" on display at the Donald Woodward farm, Le Roy, N. Y., recently. The plow, which Mr. Roe declares frees the soil from bugs and vermin through the passage of an electric current between two terminals, is being run in competition with modern farm methods used on an adjacent plot, where 900 lb. of fertilizer, five cultivations and six sprays had been applied. Products of the first harvest, displayed last week, were, farm authorities said, superior to the regular farm products.

Mr. Pilgrim is quoted as saying: "As far as my investigation has gone, the electric plow appears to do all its inventor claims it will. I saw it in operation. I am interested in the possibilities of applying electricity to the soil and am awaiting the outcome of investigations to determine what changes actually occur."

Plenary Meeting of I.E.C.

Advisory Committee Reports Adopted Unanimously When Delegates Reassemble at Rome—Many Courtesies Extended by Authorities and Fellow Technicians

AT THE plenary session of the International Electrotechnical Commission held at the Real Accademia de' Lincèi, Rome, on Sept. 22, the reports of the advisory committees were accepted unanimously. The new president, Dr. Clarence Feldmann of Holland, made a short inaugural address, praising the work accomplished during the Semenza administration and asking continued support and harmonious international co-operation.

It was announced that the commission had agreed to co-operate to some extent in certain phases of the work of the League of Nations. Denmark, Sweden and Norway united in inviting the commission to meet in Scandinavia in 1930, and, as reported last week, the invitation was accepted.

During the commemoration of the one hundredth anniversary of Volta's death, held at Como, Prof. A. E. Kennelly of Harvard University responded to an address by the Mayor and in doing so announced the completion of an endowment fund of $25,000 raised in the United States to pay the expenses of one Italian graduate each year at an American university. Maurice A. Oudin, vice-president International Electric Company, and John W. Lieb, vice-president New York Edison Company, are active supporters of this plan and cabled news of its success. The delegates also participated in a meeting held at Rome in the hall of the Italian Senate in memory of Volta, when Marconi spoke. Premier Mussolini received them in the Villa Torlonia on Sept. 20, and in Bellagio, Como, Milan, Venice, Florence, Rome, Pisa, Genoa and Turin the local authorities and electric societies showered courtesies upon them. A special train was placed at their disposal by the government.

Utilities Discuss Safety at National Congress

The economic value and methods of accident prevention in public utility operations occupied a prominent place in the program of the sixteenth annual Safety Congress in session at the Stevens Hotel, Chicago, Sept. 26 to 30. Under the chairmanship of George Opp, safety engineer with the Detroit Edison Company, the Public Utilities Section of the National Safety Council held meetings on Tuesday, Wednesday and Thursday.

Analyzing the qualifications and work of the safety director, Charles B. Scott, general manager of the Bureau of Safety, Chicago, emphasized the importance of utility executives' co-operation and support in safety work if best results are to be obtained. Once this is established it is much easier to get the rank and file of employees to consider accident prevention in the proper spirit.

Ways and means of impressing executives and operating and designing engineers with the importance of safety work were the subject of an address by Frank W. Smith, vice-president and general manager of the United Electric Light & Power Company, New York City. He deplored the fact that so much importance has been attached to the dollars-and-cents value of the safety movement. Executives are interested in the work from a broader standpoint of public welfare, Mr. Smith declared. A public utility is a business affected with a public interest, and the first and foremost argument in favor of the utmost safety precautions is the public interest in the safety of the utility workmen.

Rules for unloading poles were discussed and demonstrated by W. H. Brown of the Northern States Power Company, Minneapolis.

Discussing construction contractors' accidents on public utility properties, J. C. Sanderson of Sargent & Lundy, Chicago, called attention to the rapid growth of utility companies and the demand for their service which has speeded up construction work. Contractors, he pointed out, should be required to employ intensive safety measures, and those jobs which are best organized for safety are best organized for speed and economy.

The prevention of high-voltage hazards at industrial substation installations was discussed by Walter Wagner of the Philadelphia Electric Company, and methods of organizing for accident prevention in public utilities were the subject of a paper by H. F. Webb of the West Penn System, Pittsburgh.

More than two thousand persons attended the banquet of the National Safety Council on Wednesday evening, when the new officers were announced. The presidency went to an electrical central-station man, Homer E. Niesz, manager of industrial relations for the Commonwealth Edison Company, Chicago. G. E. Sanford of the General Electric Company was made vice-president for engineering.

Purchases and Mergers

American Electric Power Corporation Extends Holdings—Municipal Plants Continue to Be Absorbed, Though Some Refuse

THE Pennsylvania Gas & Electric Corporation has acquired control of the American Electric Power Company from the American Gas & Electric Company. The two former companies will be controlled by the recently formed American Electric Power Corporation. The acquired company controls the Wilmington (Del.) Light & Power Company, the Electric Company of New Jersey, Bridgeton, N. J., the Chester County Light & Power Company, Kennett Square, Pa., and small utility companies in Ohio and elsewhere. Last year it disposed of its West Virginia and Virginia properties to the Appalachian Electric Power Company.

The Harrisburg Light & Power Company has asked the Pennsylvania Public Service Commission's approval of purchase of two light and power companies in Dauphin County—the South Hanover-Dauphin Power & Light Company and the East Hanover-Dauphin Power & Light Company—and of four in Lebanon County—the Union-Lebanon Power & Light Company, the Swatara-Lebanon Power & Light Company, the Bethel-Lebanon Power & Light Company and the East Hanover-Lebanon Power & Light Company.

The Harlem Valley Electric Corporation has made application to the New York Public Service Commission for permission to acquire all outstanding capital stock and merge with it the Chatham Electric Light, Heat & Power Company, the Katonah Lighting Company, the Morgan & Wyman Electric Light & Power Company of Dover Plains, the Lebanon Valley Lighting Company and the Amenia Electric Light & Power Company. The franchises and systems of the five companies have been transferred to the Harlem Valley company, which is now operating under them. If the merger is permitted, the existence of the companies will be terminated.

The Long Beach Power Company has made application to the New York Public Service Commission for approval of the sale and transfer to it of the municipal electric plant and distributing system of the city of Long Beach for $1,000,000, pursuant to an order of the Supreme Court dated Sept. 1. The outstanding securities of the Long Beach Power Company have been acquired by the Queens Borough Gas & Electric Company.

Citizens of Quincy, Mich., by a vote of 336 to 1, have declared themselves in favor of receiving electric service from the Southern Michigan Light & Power Company and will sell their generating plant to the company.

As a result of a special election, the electric distributing plant at Edgerton, Minn., will be turned over to the Northern States Power Company. The line is to be rebuilt from Trosky.

Authority from the Indiana Public Service Commission is sought by the Attica (Ind.) Electric Company to buy electric properties of the Central Illinois Public Service Company situated in Warren County, Ind., in the villages of Pence, Hedrick, State Line and Illiana. They recently were bought from the Alvin Grain & Electric Company of Vermilion County.

The Central Illinois Public Service Company has completed negotiations for the purchase of the Hardin (Ill.) Electric Light & Power Company for $11,000 and will enlarge the plant and serve all Calhoun County.

A subsidiary of the People's Gas & Electric Company of Mason City, Iowa, has bought the Denmark and Augusta municipal electric and telephone plants. Light and power will be furnished from Keokuk.

A transaction whereby the Public Service Company of Oklahoma purchases the electric power plants and lines of the Dierks Lumber Company of Arkansas, known in Oklahoma as the Choctaw Lumber Company, has been completed, it is asserted on what is called good authority. A 60,000-volt power line between Fort Towson and Wight City, Okla., will be erected soon. Plants of the Dierks company are located at Valliant, Broken Bow and Idabel, Okla., and at De Queen, Dierks, Nashville, Murfreesboro and Foreman, Ark. The consideration involved was reported to be $2,000,000.

Marshall, Okla., voted unanimously Sept. 20 to sell its light and power plant to the Oklahoma Gas & Electric Company. Marshall is already connected with the transmission lines of that company.

By a majority of 79, voters of Bay Minette, Ala., approved the proposed sale by the Town Council of the municipally owned lighting and water plants to the Gulf Electric Company at an election held Sept. 16. The vote was 212 to 133. As reported previously in ELECTRICAL WORLD, the same proposition was voted down by a majority of 10 on June 7. The price to be paid is $90,000 for the two systems. The Gulf Electric Company expects to have its lines into Bay Minette within 90 days.

The Mississippi Power Company recently acquired the municipal lighting plant at Corinth, Miss.

Negotiations for the purchase of the municipal electric plants at Woodville and Centerville, Miss., by the Mississippi Power & Light Company are under way. An offer from the same company of $100,000 for the Crystal Springs (Miss.) municipal electric plant has been refused by the aldermen, who want $145,000.

Vidalia (La.) citizens will vote on the sale of their electric plant to the Louisiana Power & Light Company for $50,000.

The Islands Edison Company, subsidiary of the General Utilities & Management Company, Baltimore, has bought the Macoris Light & Power Company, operating in San Domingo, where the Island Edison also owns the San Domingo Electric Company. Assets of the Macoris company are placed at $370,000.

An agreement has been reached whereby the Canada Electric Company of Amherst, Nova Scotia, acquires the controlling interest in the plant of the Eastern Electric & Development Company, which supplies Sackville, New Brunswick, with electric light and power. This agreement is subject to the approval of the New Brunswick and Nova Scotia Boards of Public Utilities.

Reports that the Insull interests are concerned in a movement to acquire the power plant and water rights of the Amoskeag Company, a large manufacturer of textiles in New Hampshire and Massachusetts, are denied by Martin J Insull.

Fight Ban Put on Dividends by Tennessee Commission

Two petitions have been filed in the Circuit Court at Nashville against the Railroad and Public Utilities Commission of Tennessee, one by the Tennessee Eastern Electric Company and the other by five stockholders of that company. In each the petitioners seek to have the court set aside an order rendered by the commission on Aug. 10, 1927, prohibiting the payment of any dividends by the Tennessee Eastern Electric Company on its common stock until certain moneys which the order stated had been illegally expended by the company have been returned into the treasury and certain other conditions set out in the order have been complied with. The commission has, by writs of the court, been directed to certify all evidence at the October term, and, according to attorneys representing both petitioners, the order of the commission is by this procedure set aside.

The order thus attacked, which was noted under "Commission Rulings" on Aug. 27 (page 431), was one of the most drastic ever issued by the Tennessee commission and decidedly unusual in its nature.

Rochester Company Considering Mercury Turbine

Electrical engineers and officials of the Rochester Gas & Electric Corporation are investigating the advisability of installing a mercury turbine at a cost of $2,500,000. The mercury turbine, according to Thomas H. Yawger, superintendent of the electrical department, would increase the output by 20,000 kw. and would solve the problem of producing sufficient power for Rochester and vicinity pending completion of the Caneadea power dam and the coming dam at Mount Morris. High initial cost is the obstacle in the way of installing the system. Mr. Yawger pointed out that the plant would require a building 50 ft. x 75 ft. and 115 ft. high. The plant, he said, would adequately care for Rochester's yearly increase in the consumption of energy, which he put at 6,000 kw.

Seattle Must Go Slow

Federal Commission Unlikely to Issue Skagit Licenses in Advance of City's Needs—Park Commission May Modify Potomac Stand

APPLICATION to the Federal Power Commission by the city of Seattle for a license covering the development of the Skagit River above the existing Gorge plant to the Canadian border is awaiting action. Indications are that the commission will be slow in authorizing a license for the entire project, as much of the development will not be required by the city for many years to meet the growth in the demand for power. There is little doubt, however, that the Diablo Canyon development, which is the next step of the project, will be licensed, as the showing made indicates that the power will be needed in the reasonably near future. The remainder of the river to the border still would be covered by the preliminary permit which was issued to the city last spring. A condition of the permit, however, specifies that licenses will be granted only for those separate stages of the development which are warranted by the demand for power.

The People's Hydro Power Company of Alabama has applied for an extension of its preliminary permit covering a proposed development at Lock No. 2 on the Coosa River. If granted, the application would extend the preliminary permit for the full three years permissible under the water-power act. The Chamber of Commerce of Gadsden, Ala., has asked to be heard in opposition to the extension of the permit on the ground that comprehensive investigations have not been made under it and that they are not likely to be made during the period covered by the extension. It is understood, however, that the Chief of Engineers of the army has recommended that the extension be granted.

The Alhambra Mining Corporation of Gardnerville, Nev., has applied for a license covering a project on Greater Lake in Alpine County, Cal. It is proposed to erect a dam 47 ft. high and 264 ft. long to furnish a few hundred horsepower of energy to be used in mining operations.

As a result of the appearance of Robert J. Bulkley and General Charles Keller of the Potomac River Corporation before the National Capital Park and Planning Commission on Sept. 19, further field work will be done between Chain Bridge and Great Falls, and the Park Commission is expected to modify the letter which it has submitted to the Federal Power Commission opposing the project. Mr. Bulkley and General Keller made it clear that they have in mind no power project that will not harmonize with the scenic development of the river. They urged that a preliminary permit be granted to their corporation so that a detailed investigation can be made as to the extent of the conflict between power and park development and as to the possibilities of harmonizing scenic beauty with some utilization of the river's power resources. It was pointed out that no study of the Potomac ever has been made with the idea of evaluating the various factors making up scenic value. General Edgar Jadwin, the chairman of the commission, very apparently approved the reduction of scenic values to definite terms. Frederick Law Olmstead, another member, apparently was also in favor of granting the permit so that an investigation might be made.

Seattle Faces Ten-Million-Dollar Skagit Outgo

The city of Seattle will have to spend $10,000,000 within the next two years for its municipal power project on the Skagit River, J. D. Ross, superintendent of the city's light department, says in his annual report. The city has already spent $14,000,000 on this project.

As already reported, the City Council has authorized the immediate expenditure of $3,400,000 on a new tunnel and dam at Diablo Canyon. Immediately thereafter a new power plant will be needed at this point and then a new transmission line into the city, which ought to be ready by the middle of 1929. The new plant will involve an expenditure of $6,000,000. Mr. Ross also says that work should be started soon on the projected dam at Ruby Creek. The Seattle municipal power project originally was planned to develop 50,000 hp. Because of irregularity of water flow and defects in the location the actual dependable output is said to be not much more than half of this.

N. E. L. A. Industrial Heating Committee Plans Busy Year

Meeting in Detroit last week, the N.E.L.A. industrial heating committee, under the chairmanship of Walter H. Sammis, laid plans for widening activities in the publication of specific electric heating data and investigating new applications of the process. Constructive work is being done by J. L. Faden, vice-chairman, through co-operation with steel-treating, foundrymen's, electrochemical, mechanical and other associations in studying the utilization of electric heating processes in various industries.

To make available to utility companies and industrial users further information on electric heat application, the committee plans reprinting all articles on the subject appearing in the technical press. These will be issued at comparatively small cost and will be extremely valuable to power salesmen and users for reference and educational purposes. Study will also be made of electric welding from a load standpoint. Under direction of Harold J. Hall a motion picture, "Electric Heat in Industry," has just been completed. It shows a wide range of electric heating equipment in actual operation in many industrial plants in Detroit, Chicago, Milwaukee, Cleveland, Canton and other cities. Steel melting, carburizing, hardening, annealing, japanning, vitreous-enameling and tempering in electric furnaces are included with explanatory captions detailing advantages and economies gained from electric heat. The picture, which is about 4,000 ft. long, was exhibited by the N.E.L.A. industrial heating committee at the national steel and machine tool exposition in Detroit last week. The committee plans to make the film available to power companies at a nominal rental charge to be shown before local engineering associations, manufacturers and industrial groups. A most complete program has been scheduled by this committee, which will hold its next meeting Dec. 28 at the office of the Brooklyn Edison Company.

Revised Program of Southern Appalachian Conference

Following are the papers of chief interest to the electrical industry scheduled in a revised program for presentation at the Chattanooga meeting of the Southern Appalachian Power Conference on Oct. 13 to 15, noted in ELECTRICAL WORLD for Sept. 10 (page 527):

Thursday Morning.—"Pernicious Interference with the Operation of the Federal Power Act," W. H. Onken, Jr., editor ELECTRICAL WORLD; "State Regulation Versus Government Operation," Judge A. G. Patterson, formerly president Alabama Public Service Commission, and Managing Director P. S. Clapp of the N.E.L.A.

Thursday Afternoon.—"Is There a Power Combine Affecting the Public Welfare?" J. T. Newcomb, counsel for Joint Committee of National Utility Associations, and W. E. Humphreys, member Federal Trade Commission; "Power Administration from the Standpoint of the Power Producer," H. C. Couch, president Arkansas Power & Light Company, and H. P. Wilson; "Power Administration from the Standpoint of the Consumer," Mercer Reynolds, president Chatanooga Chamber of Commerce.

Friday Morning.—"Power Development in Relation to Navigation," Majors G. H. Edgerton and L. H. Watkins, U. S. A.; "State Water-Power Laws and Their Importance from the Standpoint of the Federal Water-Power Act," O. C. Merrill, executive secretary Federal Power Commission; "Does the Federal Power Act Invade the Rights of the States?" R. D. Gleaves, member Tennessee Legislature.

Friday Afternoon.—"Electrification of Rural Sections and Farms," Prof. E. A. Stewart, University of Minnesota, and O. Max Gardner of North Carolina.

Saturday Morning.—"Use of Power from Muscle Shoals," Senator F. M. Sackett of Kentucky, former Representative J. H. Small, L. O. Crosby, president Mississippi State Development Board; former Secretary of Commerce W. C. Redfield and former Congressman A. F. Lever.

N. E. M. A. Issues Program for Apparatus Division

Market development will be the keynote of the Briarcliff (N. Y.) meeting of the Apparatus Division, National Electrical Manufacturers' Association, during the week of Oct. 24. The division meeting will have a general program on Monday evening on the subject of market development for electrical apparatus. Subjects and speakers for that evening will be: "Manufacturers of Electrical Apparatus and the Market," J. M. Curtin, vice-president, Apparatus Division; "The N. E. M. A.'s Position in Market Development," Gerard Swope, president N. E. M. A.;

"The Joint Committee on Market Development," W. E. Sprackling; "The Position of the Policies Division Toward Market Development," C. L. Collens, vice-president, Policies Division; "How the Development of Electrical Supply Markets Increases Apparatus Sales," D. H. Murphy, vice-president, Supply Division; "The Relation of the Radio Business to Electrical Apparatus Sales," L. B. F. Raycroft, vice-president, Radio Division.

Morning sessions will be devoted to section meetings and business. There will be a banquet Thursday evening and a meeting of the board of governors in New York City on Tuesday evening. On Thursday morning a meeting of the board will be held in conjunction with all officers of the sections and divisions. The division will meet at Briarcliff Lodge.

A. S. M. E. to Hold National Fuels Convention

A "national fuels convention," sponsored by the fuels division of the American Society of Mechanical Engineers, is to be held in St. Louis on Oct. 10-13. The features of the convention will be addresses and discussions on the production, purchase, classification and the proper burning of fuel. Topics pertaining to fuel use will be discussed from the domestic, industrial and power viewpoints.

Outstanding engineers and scientists in the fuel field will participate, and among the papers and addresses will be the following: "American Fuel Resources," O. P. Hood, chief mechanical engineer United States Bureau of Mines; "Combustion and Heat Transfer," Prof. R. T. Haslam and H. C. Hottel, Massachusetts Institute of Technology; "The Clinkering of Coal Ash," A. C. Fieldner, chief engineer of experiment stations, United States Bureau of Mines; "Factors Governing the Purchase of Fuels," Morgan B. Smith, engineer General Motors Corporation; "Refractories for High Temperatures," Stewart Phelps, director of research and tests Mellon Institute; "Recent Developments in Low-Temperature Coal Carbonization," H. D. Savage, vice-president Combustion Engineering Corporation; "Industrial Applications of Heat," Prof. W. Trinks, Carnegie Institute of Technology: "The Burning of Liquid Fuels," Ernest H. Peabody, president Peabody Engineering Corporation; "Application of Powdered Fuel to Smaller Boiler and Industrial Installations," H. W. Brooks, consulting engineer Erie City Iron Works; "The Relative Values of Gaseous, Liquid and Solid Fuels," F. C. Binnall, assistant manager Standard Sanitary Manufacturing Company.

Other topics will be: "Characteristics of Modern Boilers," E. R. Fish, vice-president Heine Boiler Company; "Characteristics of Modern Stokers," F. H. Daniels, president Riley Stoker Company, and "Air Preheaters," Frank M. Van Deventer, special engineer, Henry L. Doherty & Company.

Briefer News

IDAHO TOWN STICKS TO CENTRAL-STATION SERVICE. — Voters of Buhl, Idaho, which is served by the Idaho Power Company, have defeated, by a vote of 185 to 99, a proposed bond issue of $85,000 for the purchase of a power site and construction of a power plant.

MISSISSIPPI POWER COMPANY COMPLETES A TRANSMISSION LOOP.—By cutting into service 27 miles of 44,000-volt transmission lines the Mississippi Power Company has completed a loop which gives an additional source of power to the entire northeast section of Mississippi. The system includes 110,000, 44,000 and 13,000-volt lines in Mississippi and Alabama.

FITTING A SUBSTATION TO ITS SURROUNDINGS.—An example of a substation that is an ornament rather than a detriment to its surroundings is the new Weidler substation of the Northwestern Electric Company, Portland, Ore. The ground immediately about this building

has already been made attractive by the company, although it has not yet finished the landscaping that it plans, or had not when the photograph was taken. The building is illuminated at night by colored floodlamps so constructed that various scenic effects can be produced.

NEW UNIT FOR SIOUX CITY.—Plans for an addition to the Big Sioux power station of the Sioux City (Iowa) Gas & Electric Company, to cost $760,000, have just been announced by W. J. Bertke, president and general manager. Work is to begin immediately, and the addition is to be completed a year from now. It is to house a third 10,000-kw. turbo-generator unit, increasing the possible output of the Big Sioux station from 20,000 kw. to 30,000 kw.

RANKINE-SCHOELLKOPF MEMORIAL UNVEILED AT NIAGARA FALLS.—Last Saturday afternoon, Sept. 24, the Niagara Falls (N. Y.) Memorial Commission unveiled on the City Hall plot memorials to the pioneers of Niagara Falls power development and to William B. Rankine and Arthur Schoellkopf, in recognition of their efforts in developing the two great electric power plants of Niagara. There was an address by Cuthbert W. Pound of Lockport, N. Y., judge of the Court of Appeals.

TEN MORE MANITOBA TOWNS GO ON LINES OF POWER COMMISSION. — Following the completion of extension work by the Manitoba Power Commission at a cost of $250,000, power was turned on two or three weeks ago in ten towns of the province, including Jordan, Altamont, Manitou, Darlingford, Somerset, Swan Lake, Cardinal and Notre Dame des Lourdes. Further extensions are in progress which when completed will bring the total expenditure on extension work this season up to approximately $400,000.

PROVINCIAL PREMIERS TO TAKE UP OTTAWA RIVER QUESTION THIS MONTH.—The power situation at Carillon Falls, on the Ottawa River, to which frequent reference has been made in recent months, will be dealt with at a conference of provincial premiers in Ottawa in October. One point to be determined is whether all the water-power sites on the Ottawa River and the St. Lawrence River are to be treated in one general policy or each dealt with separately.

NEW GENERATING UNIT FOR ROANOKE, VA.—Improvements which will entail an expenditure of $181,000 and will almost double the generating capacity of the Walnut Avenue steam station of the Appalachian Electric Power Company at Roanoke, Va., are being made, according to announcement by W. I. Whitfield, manager of the power company at Roanoke. A General Electric 7,500-kva. turbo-generator is being installed and is expected to be in operation by the middle of November.

PUSHING WORK ON CANEADEA DAM FOR ROCHESTER COMPANY.—In an effort to complete the dam under way across Caneadea Creek at Rushford, N. Y., for the Rochester Gas & Electric Corporation early next year, the company's engineering department is using two ten-hour shifts of 200 men each, E. R. Crofts, head of the department, says. Construction equipment is idle only four hours of the day. It is planned to pour most of the concrete by the first of November, after which heating plants will be in operation.

BINGHAMTON-ELMIRA CONNECTION IN NEW YORK WILL BE READY SOON.—A 110,000-volt transmission line which is being built by the Empire Power Corporation between Binghamton and Elmira, N. Y., will, it is reported, be ready for service in about 60 days with the completion of substations. A similar line from Elmira to Geneva, N. Y., is planned for the future and will connect with the transmission line of the Niagara, Lockport & Ontario Power Company. A 6,000-kw. unit is to be added at Elmira.

PROGRESS IN GULF COAST DISTRICT OF TEXAS.—The 83-mile transmission line between the plants of the Central Power & Light Company at Corpus Christi and Victoria, Tex., has been

completed, and extensive improvements to the plant at Corpus Christi have been made. A line from Skidmore to Orange Grove has made it possible to serve these towns without the use of a temporary plant built last year at Mathis. Woodsboro and Refugio are being supplied from a plant at Refugio. The transmission line from Corpus Christi to Robstown has been rebuilt. The company has built substations at Beeville, Skidmore, Sinton, Taft, Robstown, Agua Dulce and Alice.

SUIT OVER LONG BEACH (N. Y.) PLANT SETTLED.—A suit brought by a taxpayer of the city of Long Beach, N. Y., to restrain the sale of the municipal lighting plant to the Long Beach Power Company, a subsidiary of the Queens Borough Gas & Electric Company, has been settled, the company agreeing to pay $1,000,000 to the city for the plant. A flat rate for householders of 10 cents a kilowatt-hour has taken the place of rates averaging 15 cents in the winter and 20 cents in the summer, and business concerns which paid 5 cents to 6 cents now pay 3 cents. The Long Island Lighting Company is adding 50,000 kw. of generating capacity to its system. This is divided equally between the Far Rockaway and Glenwood Landing plants of the company.

THIRD SECTION OF CAHOKIA PLANT UNDER WAY.—The first unit of the third section of the Union Electric Light & Power Company's Cahokia generating station on the Mississippi River south of East St. Louis, Ill., will be completed before Nov. 1. It is rated at 50,000 kw. The first section of the plant, consisting of two units aggregating 70,000 kw., went into service in 1923. In August, 1924, another 35,000-kw. unit was installed, and in May, 1925, a fourth unit of 40,000 kw. Eventually Cahokia will have a capacity of 350,000 kw.

HEARING ON CALIFORNIA HYDRO-ELECTRIC PROJECTS.—A public hearing will be held in San Francisco on Oct. 6 by the district engineer of the Forest Service on two applications now before the Federal Power Commission for the authorization of hydro-electric plants. One is the Yosemite Power Company's project for three power plants along the south fork of the Tuolumne River and a diversion canal from the middle fork of that river to the Crocker Reservoir. The other is the Turlock Irrigation Company's proposal to build a diversion conduit, storage reservoir and other appurtenances in the vicinity of the south and middle forks of the Tuolumne River and Big Creek.

COMING CONFERENCE ON ENGINEERING MATERIALS AT BERLIN.—The program for this conference, allusion to which was made in the ELECTRICAL WORLD for July 23 (page 183), and which will be held from Oct. 22 to Nov. 13, has been issued. Many lectures are to be given, some of especial interest to electrical men covering materials for power plants, aluminum and its alloys, materials for boiler and turbine design, copper and copper alloys, standardization of materials, physical and chemical tests, iron, steel and other metals in electrical engineering, and insulating materials. Details of the conference may be had from the Geschäftsstelle der Werkstofftagung, Berlin N.W.7, Ingenierhaus.

ST. LOUIS COMPANY BUYS ITS HOME.—The Union Electric Light & Power Company of St. Louis has purchased the fourteen-story office building at Twelfth Boulevard and Locust Street which it has occupied for the past fifteen years. It is said that the company paid $1,500,000 cash for the building, of which it is now sole owner.

NEW OFFICE BUILDING FOR DUKE INTERESTS IN CHARLOTTE.—The erection of a five-story building at Charlotte, N. C., to be occupied by the Southern Power Company, Southern Public Utilities Company and other Duke interests was started recently. The new building is going up on South Church Street and is to be connected by a bridge to the Mercantile Building, now used by these companies. It will be 128 ft.x151 ft., of reinforced concrete with front of buff pressed brick and limestone trimmings above a base of polished granite.

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see the ELECTRICAL WORLD for July 2, page 50.]

American Electric Railway Association—Cleveland, Oct. 3-7. J. W. Welsh, 292 Madison Ave., New York.

Empire State Gas and Electric Association—Lake Placid Club, Lake Placid, N. Y., Oct. 6 and 7. C. H. B. Chapin, Grand Central Terminal, New York.

American Society of Mechanical Engineers—St. Louis, Oct. 10-13. C. W. Rice, 29 West 39th St., New York.

Illuminating Engineering Society—Edgewater Beach Hotel, Chicago, Oct. 11-14. L. H. Graves, 29 West 39th St., New York City.

Eastern Association of Electrical Inspectors—Springfield, Mass., Oct. 12-13. E. P. Slack, 85 John St., New York.

Southern Appalachian Power Conference—Chattanooga, Tenn., Oct. 13-15.

Rocky Mountain Division, N.E.L.A.—Broadmoor Hotel, Colorado Springs, Col., Oct. 17-20. O. A. Weller, 900 15th St., Denver.

National Association of Railroad and Utilities Commissioners—Dallas, Tex., Oct. 18-21. James B. Walker, 270 Madison Ave., New York.

Kansas Section, N.E.L.A.—Lamer Hotel, Salina, Kan., Oct. 20-21. H. L. Jones, 401 National Reserve Bldg., Topeka.

National Electrical Manufacturers' Association—Apparatus Division, Briarcliff, N. Y., Oct. 24-27; Radio Division, Edgewater Beach Hotel, Chicago, Nov. 28-Dec. 1. S. N. Clarkson, 420 Lexington Ave., New York.

Public Utilities Association of West Virginia—Parkersburg, W. Va., Oct. 26-27. A. B. McCrum, 514 Charleston National Bank Bldg., Charleston.

New England Central Station Association of Power Engineers—Chamber of Commerce, Boston, Nov. 2. T. D. Bond, C. H. Tenney & Co., Boston.

Electrical Supply Jobbers' Association—Book-Cadillac Hotel, Detroit, Nov. 14-18. F. Overbagh, 411 S. Clinton St., Chicago.

FIRST UNIT OF CHELAN HYDRO PLANT GOES ON LINES.—By touching a button at his Spokane home on Sept. 16, D. L. Huntington, president of the Washington Water Power Company, set in motion the first generating unit of the Lake Chelan hydro-electric project. This plant was described and illustrated in the July 16 issue of the ELECTRICAL WORLD (pages 104 and 132). The generator, rated at 32,200 hp., went on the lines with perfect smoothness. No ceremony further than a telephonic announcement of progress to the president, 200 miles away, marked its starting.

SAN FRANCISCO TO VOTE ON TRANSMISSION-LINE BONDS.—By the action of the San Francisco Board of Supervisors already reported in these columns voters of that city will be asked at the November election to pass upon a two-million-dollar bond issue for extending the city's Hetch Hetchy transmission line to the city. The line now ends at the Newark substation of the Pacific Gas & Electric Company, about 35 miles from San Francisco, at which point the city is selling the entire output of its 70,000-kw. municipal hydro-electric plant to the private company. The proposed extension of the line to San Francisco is in anticipation of the time when the city hopes to be able to condemn one of the privately owned distribution systems now serving the city.

MOUNTAIN STATES POWER COMPANY STARTS TO BUILD 85-MILE LINE IN WYOMING.—Contracting for a block of power from the United States Reclamation Service plant at Guernsey, Wyo., sufficient to supply the needs of the territory for some years, the Mountain States Power Company of Tacoma, Wash., has completed preliminary surveys and has commenced construction of 85 miles of 57,000-volt line to bring this power to its Casper (Wyo.) system at Parkerton. The new line will pass through Douglas and Glenrock and connect with an existing 33,000-volt line extending from Casper to Parkerton. At present Parkerton and Glenrock are served by the Casper steam plant, the capacity of which would have had to be increased soon to care for the growing demands of the territory. Douglas is served by an isolated plant without transmission connection to outside sources. The new line will also open up the possibility of irrigation by electric pumping of 20,000 acres adjacent to it.

UNIFIED POWER SYSTEM OF WEST TEXAS UTILITIES.—The electric transmission network of the West Texas Utilities Company, according to recent official figures, now comprises 1,350 miles of high-voltage trunk lines, over which power is dispatched from the large generating stations at Abilene and San Angelo and many auxiliary generating stations placed at strategic points throughout the system. This unified power system now reaches from the oil fields of Crane, Pecos, Upton and Crockett Counties on the southwest and the hill country of Junction, Menard

and Mason on the south to the Red River on the north. The growth and expansion of this company, which five years ago served only eight towns with a total of only 5,983 customers and today serves 83 towns with a total of 40,000 customers, has been one of the outstanding achievements in the industrial development of the Southwest.

PLANS FOR NEW HYDRO PLANT ON THE OSWEGATCHIE.—An inspection party representing the St. Lawrence Utilities Company recently visited Eel Weir on the Oswegatchie River, N. Y., with a view to its purchase. Plans for the erection of a 14-ft. dam and a power house to develop 2,000 hp. are said to be under way. This will be 500 more horsepower than the company obtains from its Heuvelton unit. The site in question is 5 miles south of Ogdensburg.

UMATILLA RAPIDS PROJECT.—Information on the Umatilla Rapids hydroelectric project was given recently to the House of Representatives' committee on irrigation and reclamation at a meeting held in The Dalles, Ore. Marshall N. Dana, an officer of the Umatilla Rapids Association, said that 420,000 hp. could be developed. The cost of the plant was put at between fifty and sixty million dollars. Mr. Dana said that if the electrical energy generated were sold for 2 mills a kilowatt-hour, the cost would be recouped in 45 years. Advocates of the project put it ahead of the Columbia River proposal because of the greater amount of power involved as compared with the irrigation feature of the development.

LACLEDE COMPANY TO BUY ELECTRICAL ENERGY PRODUCED FROM BLAST-FURNACE GAS.—In a suit brought by minority stockholders of the St. Louis Coke & Iron Company to prevent its reorganization by the Utilities Power & Light Corporation, under whose control the coke company now is, it was brought out that contracts by another controlled company—the St. Louis Gas & Coke—to supply gas and electricity to the Laclede Gas Light, Laclede Power & Light and Illinois Power & Light companies will lead to changes in plant facilities by which it is estimated the St. Louis Gas & Coke will produce approximately 56,000,000 kw.-hr. of electrical energy annually through the conversion of blast-furnace gas into electricity.

VARIOUS ACTIVITIES IN KANSAS.—Construction has begun on a 23-mile, 33,000-volt transmission line from the Fairport (Kan.) oil fields to the newly opened Natoma fields, it is announced by the Central Kansas Power Company. The line will be constructed for an eventual capacity of 66,000 volts. Electrical energy will be used exclusively for both drilling and pumping in these fields.——Early construction of a high-tension transmission line to serve Walton, Kan., has been announced by the Kansas Gas & Electric Company. This line will be built from Newton, 30 miles north of Wichita.——Terminating an extended controversy respecting municipal generation of electricity, Oswego, Kan., has entered into a contract for the purchase of its requirements from the Kansas Electric Power Company.——Construction has begun on a series of sixteen 1,250,000-cp. beacon lights on the air-mail trail between Kansas City and Wichita, the first one having just been completed 2 miles northwest of Olathe, Kan.

Commission Rulings

UNIFORM RATES FOR LIGHTING AND COOKING APPROVED TO AVOID UNFAIRNESS.—In substituting a uniform rate for a tariff of the Keystone Power Corportation imposing a lower rate for energy used in cooking than for energy used in lighting, the Pennsylvania Public Service Commission said: "The evidence discloses that a minority of the patrons, having a cooking circuit readily available, were enabled to get the advantage of the low cooking rate for general household appliance use, while the large majority of patrons, not having the duplicate circuits, were required to pay the higher rate for the same energy used in operating similar appliances."

INDIANA COMMISSION REFUSES TO APPROVE MORE "ACTIVE-ROOM" SCHEDULES.—The Indiana Public Service Commission has taken a definite stand against further adoption of the "active-room" basis for consumption of electrical energy. This was learned on the refusal of the commission to permit the Northern Indiana Power Company, an Insull property, to file schedules of rates on the "active-room" basis for Zionsville, Whitestown, Colfax and West Lebanon. At Martinsville and Huntington the commission allowed these systems as optional schedules, but it has voted unanimously against permitting additional schedules to be filed unless substantial evidence from the two tests now being conducted shows that they are preferable to the present basis of fixing rates on kilowatt-hour consumption. The "active-room" plan is now offered as an optional schedule for consumers at Martinsville by the Wabash Valley Electric Company and at Huntington by the Northern Indiana Power Company.

APPROVAL OF CONTRACT REFUSED WHERE VOTERS ELECT COUNCILORS OPPOSED TO IT.—The Pennsylvania Public Service Commission has disapproved a contract for supplying electrical energy entered into between the United Electric Light Company of Wilmerding and the Borough of Pitcairn. In this case the borough had its own plant, energy from which was supplemented by an emergency supply from a competitor of the contracting company. The majority of the members of the Council which made the contract were defeated at an election held before the effective date of the contract, and the new Council found that the contract was unnecessary. The commission therefore held that it was not called upon either to approve the contract or to suggest conditions under which it would give its approval.

DISCRIMINATION IN RURAL SERVICE.—In ordering the town of Hagerstown, which has a municipal electric plant, to establish comprehensive rules covering its service to adjacent rural districts, the Indiana Public Service Commission ruled that a municipal electric utility having constructed a rural line and having accepted patronage upon the same cannot discontinue service because of refusal of patrons to sign an agreement to maintain such line; that it is unfair to a municipal utility's patrons living in the town for the utility to own a part of a rural line and render service to rural patrons over that line without charging them anything on account of investment, and that it is not equitable as between rural patrons of a municipal electric plant to build and furnish free of cost a line for service to some patrons and at the same time to require others to construct the line by which they are served and donate it to the utility.

Recent Court Decisions

DUTY OF UPPER RIPARIAN OWNER TO LOWER OWNER.—The Supreme Court of Oregon, in Dunn vs. Henderson, a suit for damages because a dam erected by defendant interfered with the irrigation of the plaintiff's land, found that upper riparian proprietors impounding more water than they use and preventing the surplus from flowing to the lands of another, violate the latter's right to use water for irrigation purposes, whether he claim as prior appropriator or lower riparian proprietor, and that a court of equity, having properly taken jurisdiction, could award damages. (258 Pac. 183.)*

REASONABLE CARE IN MAINTENANCE OF ELECTRIC WIRES MEANS GREAT CARE.—Simpson vs. Jersey Central Power & Light Company was a suit for damages because of the death of a boy who came into contact with a charged electric wire when a pole fell in front of a truck in which he was riding. The Supreme Court of New Jersey upheld, though with reduced damages, a verdict for the plaintiff, holding that questions of ownership of the pole, knowledge of its defective condition, contributory negligence, etc., were for the jury to decide and that the trial judge did not err when he charged that "reasonable care" in the maintenance of electric wires means great care. (138 At. 114.)

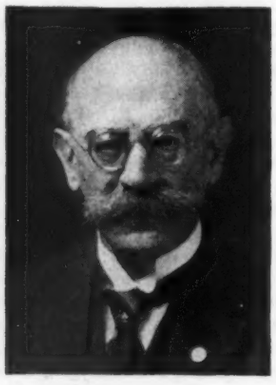
*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

News About Men of the Industry

C. Feldmann New Head of I.E.C.

Clarence Feldmann, professor of electrical engineering at the University of Delft, Holland, was elected president of the International Electrotechnical Commission at the recent meeting of that body in Bellagio, Italy. Though a native of New York City, Professor Feldmann received his technical training at the University of Darmstadt, Germany, and has spent his entire career on the European Continent.

In 1889 he entered the electrical engineering laboratory of the central-station office of Ganz & Company, Budapest, remaining one year, then removing to Cologne, where he became identified with the Helios Company in the capacity of electrical engineer. After serving as municipal engineer for the central station at Cologne he was named chief electrician of the Helios Company, a position he occupied from 1894 to 1902. Returning to his Alma Mater, he lectured there for three years before joining the teaching staff of the University of Delft. Professor Feldmann has written extensively for the technical press, his outstanding contributions being "Theory and Calculation of Electrical Networks," "Transformers," "Handbuch



CLARENCE FELDMANN

der Elektrischen Beleuchtung" and "Theory of the Asynchronous Generator." He is a member of the Royal Institute of Engineers, The Hague; Elektrotechnischer Verein, Berlin; Verein Deutscher Ingenieure, Berlin, and other electrical societies in Zurich and Vienna.

PROF. L. K. RAMZIN, director of the Thermotechnical Institute of Moscow, has arrived in the United States to make a study of American electric power stations. Professor Ramzin, who is accompanied by his assistant, A. I. Moroz, is an authority on furnace and boiler equipment of electric power plants. He has published more than 150 studies, some of which have been translated into English and French. Professor Ramzin purposes to visit within the next three months power plants and power-plant equipment works in various cities of the United States, including New York, Providence, Baltimore, Detroit, Chicago, St. Louis and Los Angeles. He expects, while studying American ways of fuel utilization, to bring about an exchange of technical information on the subject between American and Russian engineering authorities.

L. V. Sutton Manager of Mississippi Utility

L. V. Sutton, who has been appointed general manager of the Mississippi Power & Light Company to succeed C. P. Couch, recently resigned as vice-president and general manager, is considered one of the most experienced and capable power executives in the South. The foundation of Mr. Sutton's education was laid at Richmond, Va., his native city. Following graduation from the Virginia Polytechnic Institute as an electrical engineer, he became identified with the General Electric Company, in whose works he received thorough and practical engineering training. He then joined the Carolina Power & Light Company at Raleigh, N. C., as engineer, was later promoted to be commercial manager and shortly afterward to assistant general manager. It was in 1924 that Mr. Sutton removed to Little Rock as assistant general manager of the Arkansas Central Power Company, the position he occupied until his recent appointment with the Mississippi Power & Light Company.

C. E. BENNETT, formerly manager of the electrical department of the Georgia Power Company, has been appointed general engineer in charge of the engineering department. Mr. Bennett has been with the company for more than fifteen years, having been the electrical engineer for the construction of the company's first major hydro-electric development, the Tallulah Falls power plant. He was named manager of the electrical department more than a year ago.

R. V. BINGAY, president of the Pittsburgh Transformer Company and a director of the Allis-Chalmers Manufacturing Company of Milwaukee, sailed for Europe Sept. 28 aboard the Cunard liner *Maurctania*. Mr. Bingay is planning to motor through rural England, Scotland and Wales. While in England he will study particularly the London municipal stations and the interconnection of them, especially the St. Pancras station, one of the most noted of the municipal stations of London. Mr. Bingay will also inspect some of the central stations in France.

K. A. McIntyre Named S.E.D. Managing Director

Kenneth A. McIntyre, who has been in temporary charge of the Society for Electrical Development staff operations since January, was appointed managing director of the society by the executive

K. A. MC INTYRE

committee at the annual meeting held on Sept. 15, as reported last week. His elevation to the managing directorship of the society is the culmination of a six-year period during which he traveled extensively for the society throughout the United States and Canada, first as field representative and later as head of the league and field department. In this work Mr. McIntyre has played an active and practical rôle in the society's relations with the local electrical leagues, studying their problems in the field and assisting in developing league activities and in the organization of many of the leagues now in existence.

Behind this six years of active work during an important stage in the evolution of the society Mr. McIntyre's background stretches through twelve years in the electrical contracting business, he having been vice-president of Beattie-McIntyre, Ltd., Toronto, Canada, and having before that done business under his own name in Toronto and New York. For five years he was active in association work, being president of the Toronto Electrical Contractors' Association, chairman of the Ontario Association of Electrical Contractors and Dealers and a member of the executive committee of the Association of Electragists International. Born in 1889 in Halifax, Nova Scotia, he was educated in the public schools of California, Massachusetts and New York and at Columbia University.

W. B. WOODHOUSE, general manager of the Yorkshire Electric Power Company and a past-president of the British Institution of Electrical Engineers, is visiting the United States and Canada this month to acquaint himself with re-

cent electrical engineering progress. Mr. Woodhouse, who has been prominently identified with the development of electric power supply in Great Britain, is president of the British Electrical Research Association, a past-president of the Electrical Development Association and a British delegate to the International Electrotechnical Commission.

H. C. Sutton Receives New Appointment

H. Craig Sutton, who has been connected with the United Gas Improvement Company since 1913, has been appointed electrical engineer for that company. A graduate of Cornell University, Mr. Sutton has had an active career in the electrical industry and has been

H. C. SUTTON

an important factor in committee work of the National Electric Light Association, the American Institute of Electrical Engineers and the American Gas Association.

Previous to his connection with the United Gas Improvement Company, Mr. Sutton was affiliated with the General Electric Company at Schenectady and with the Oregon Power Company at Eugene. At the present time he is a member of the committee on standardization of electrical practice of the Public Utilities Commission of Connecticut; power-line construction committee, State of Pennsylvania; chairman of the overhead systems committee of the National Electric Light Association and a member of that association's committee on the revision of the National Electrical Safety Code. In addition Mr. Sutton is a member of the research sub-committee of the American Gas Association's committee on electrolysis.

A. K. MacNaughton has been appointed electrical engineer of the Narragansett Electric Lighting Company, Providence, R. I., reporting to the general manager. He will co-operate with the general superintendent and the superintendents of production and distribution, but will have no jurisdiction over any operating department. Mr. MacNaughton was educated at the University of Michigan and after being employed in the assay laboratories of the Calumet & Hecla Mining Company joined the operating organization of the El Paso Electric Railway. During subsequent transfers to other properties under the executive management of Stone & Webster, Inc., he served as general superintendent of the Ponce Railway & Light Company of Porto Rico, assistant chief engineer and later superintendent of distribution of the Blackstone Valley Gas & Electric Company, in Rhode Island. More recently he has been in the home office of Stone & Webster, Inc., as an electrical engineer in the construction division.

Thomas N. McCarter, president of the Public Service Corporation of New Jersey, Newark, returned from abroad Sept. 22 aboard the Hamburg-American liner *Resolute*.

Wilbur L. Lafean has been appointed president and treasurer of the Naugle Pole & Tie Company, Chicago. Mr. Lafean for the last five years has been vice-president of the National Pole Company, Escanaba, Mich., and previous to that connection served for about ten years as secretary and treasurer of the Naugle Pole & Tie Company. A. T. Naugle, formerly president and treasurer of the company, is now chairman of the board.

A. G. Neal has been appointed manager of the Fitchburg (Mass.) Gas & Electric Light Company, succeeding F. L. Ball, who has been elected a vice-president of Charles H. Tenney & Company, Boston, managers of the above property. Mr. Neal joined the Tenney organization in 1913 at Revere, Mass., and has been assistant manager at Fitchburg for the past eight years.

James M. Wakeman, well known in electrical circles in the United States, sailed from Liverpool Oct. 1 aboard the *Baltic* following a six months' visit to Europe. During his stay abroad Mr. Wakeman covered England, Wales, Scotland, France, Belgium, Italy, Germany, Austria and Switzerland.

Obituary

Prof. Guglielmo Mengarini, one of the founders of the Italian Electrotechnical Association, died recently in Rome.

Thomas W. D. Worthen, for fourteen years a member of the New Hampshire Public Service Commission, died on Sept. 21 at Middletown Springs, Vt., at the age of 81. He was a native of Thetford, Vt., and for 37 years was an instructor and professor of mathematics at Dartmouth College. He was appointed to the New Hampshire commission in 1911 and was an authority on rate regulation, besides serving on many important committees of the National Association of Railroad and Utilities Commissioners.

Charles A. Paul, general manager of the Bridgeport (Conn.), branch of the United Illuminating Company died at his summer home at Trumbull, Conn., Sept. 22. Thirty-two years ago he entered the employ of the Bridgeport Electric Light Company. By application and study he fitted himself to be manager and was appointed to that position in 1902, when the merger with the United Illuminating Company was accomplished.

Mr. Paul was a native of Bridgeport and was educated in the public schools of that city. His death followed an extended period of ill health.

Warren F. Hubley

Warren F. Hubley, president and general manager of the American Transformer Company, Newark, N. J., whose death was announced in the Sept. 24 issue of the Electrical World, had been identified with that organization since 1904. In the course of those twenty-odd years the American Transformer Company has grown substantially, and Mr. Hubley was an important factor in its development and progress. A native of Lancaster, Pa., he received his education at Franklin and Marshall College. His responsibilities as chief executive and general manager of the American Transformer Company did not prevent him from devoting time to other interests. He was prominent in the affairs of the American Institute of

W. F. HUBLEY

Radio Engineers, being treasurer at the time of his death. In addition Mr. Hubley was a director of the National State Bank of Newark, treasurer of the Episcopal City Mission of Newark and a member of several civic and athletic associations. Mr. Hubley's death occurred Sept. 19 at his home in East Orange, where he had lived for 21 years.

Ralph A. Gill, resident manager of the Western Public Service Company at Holdrege, Neb., died suddenly Sept. 20.

Financial and Statistical News

Upward Move Under Way Some Retrenchment Reported Bond Buying Active

THE fact that several new high prices were established this week among the public utilities right in the midst of broad selling movements in industrials has been taken as of more than usual significance. It is not the first time that these issues have tended upward while the greater part of the market was slipping. It is probably the first time it has occurred on such a large scale.

Notwithstanding this wide variation of financial opinion as to possible market movements during the remainder of the year, there is a rather remarkable unanimity on the outlook for the utilities. Many brokers and investment authorities are convinced that the next big group of stocks to move will be the utilities and that in this group power and light issues will take first place. Reasons put forward for the prospect of such a movement are convincing. The money situation is decidedly favorable and will be more so if the much predicted slowing up in some other lines should materialize. Statements of earnings continue to show a satisfactory increase in profits and merger rumors are still a buoyant factor in certain sections. It is true there are some indications of retrenchment in expansion and development programs. Properly interpreted such policies merely reflect the fact that extensions and additions to equipment in many cases have been on such a scale as to result in a catching up to or probably overtaking service requirements. Existing equipment in many cases will take care of the needs of the moment. This does not necessarily reflect any anticipated falling off in business, as would be the inference in the manufacturing industry, for example, where productive capacity is much more sensitive to indicated consumption. Furthermore, increased economies will not injure the position of the companies.

Utility common stocks that have received special attention this week include North American, Pacific Gas & Electric, Southern California Edison, etc. Several of the preferred issues, such as Standard Power & Light, Southern California Power and Standard Gas & Electric prior preferred, reached higher levels. Bonds continue in active demand without much change in price levels, despite the low yields now existing. One house dealing extensively in public utility bonds states that its regular bond customers are still buying bonds at a reduced yield rather than switching to more remunerative classes of securities.

DIRECTORS AUTHORIZE ISSUANCE OF STOCK.—Directors of the Utilities Power & Light Corporation at a meeting held recently authorized the issuance of 66,553 shares of class A stock, 10,000 shares of which have been underwritten at a price in excess of $25 per share, and 40,000 shares more are covered by an option expiring Oct. 1, 1927, at a price in excess of $25 per share. Proceeds from the sale of this stock will be used for corporate purposes.

Volume of Financing Largest Since May

Power and Light Companies Take Advantage of Present Money Market Principally for Refunding Purposes —4½ per Cent Issues

PRESS reports indicating a falling off in the volume of financing by public utilities, and implying a probable continuation of such a trend, have proved premature. The total amount of money publicly raised by power and light companies during September exceeds $97,599,500, the largest total since May.

As has been the case during the recent months, the bulk of this money is for refunding purposes. In many cases a substantial saving in annual interest charges has been effected. One of last month's issues, that floated by the Pacific Gas & Electric Company, carries a 4½ per cent rate. This is the third large piece of financing of the year which has been carried out on a 4½ per cent basis, the other two companies which have sold bonds at this rate being the Commonwealth Edison Company and the Duquesne Light Company. Application has been made by the New York Power & Light Company for permission to issue a seventy-million-dollar first mortgage issue of 4½ per cent bonds.

September brought to a close the third quarter of the year, and during the nine-month period new financing by the electric light and power companies amounted to $1,037,016,200, as compared with $894,106,482 for the similar period of 1926.

Security Issues of Electric Service Companies in September

Name of Company	Amount of Issue (Par Value)	Period Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Central Power Co.	$3,200,000	30	First mortgage gold bonds, series D	To refund bonds, for the acquisition of property, to partially reimburse treasury for expenditures on additions and for other corporate purposes	5	96¼	5.25
Queens Borough Gas & Electric Co.	1,200,000	28	Refunding mortgage gold bonds	To reimburse for additions and improvements to the properties of the company	5	103⅛	4.75
United Light & Railways Co.	25,000,000	25	Gold debentures	To reimburse for expenditures made in connection with the acquisition of certain of its holdings and for other corporate purposes	5¼	99⅛	5.53
West Penn Electric Co.	8,300,000	..	Cumulative preferred stock	To purchase additional securities of subsidiaries to effectuate retirement of funded debt and preferred stock, for the acquisition of additional properties and for other corporate purposes	6	100	6
Southern California Edison Co.	30,000,000	25	Refunding mortgage gold bonds	To retire bonds for extensions to the properties of the company	5	100	5
American Superpower Corpn.	2,462,500	..	First preferred stock	To acquire additional interests in certain electric light and power companies and for other corporate purposes	6	98⅛	6.10
Associated Gas & Electric Co.	2,375,000	..	Preferred stock	To retire indebtedness	6	95	6.32
Pacific Gas & Electric Co.	15,000,000	30	First and refunding mortgage gold bonds	To retire bonds	4¾	96	4.75
Long Island Lighting Co.	1,000,000	..	Cumulative preferred stock	Additions, extensions and improvements to properties	6	100	6
Atlantic City Elec. Co.	2,762,000	29	First and refunding mortgage gold bonds	To reimburse for expenditures made in the acquisition of new properties and for other corporate purposes	5	100	5
Texas Power & Light Co.	4,000,000	29	First and refunding mortgage gold bonds	.....	5	98	5.13
Jersey Central Power & Light Co.	2,300,000	20	First mortgage and refunding gold bonds	To reimburse for additions and extensions	5	96⅛	5.25
Total	$97,599,500 (par value)						
Total amount actually realized	$96,480,313						

Electrical Development in Denmark

A recent publication of the statistical department of the government of Denmark gives detailed engineering and financial data on the 128 urban and regional electric supply systems and 342 rural plants in that country for the year 1925-26. The total energy output, 275,741,000 kw.-hr., is equivalent to 80 kw.-hr. per capita, or about one-seventh as great as in the United States, but the use of electricity is nevertheless widespread, there being 22 customers per 100 of population against 16 in the United States. This includes both light and power. In four years the central-station horsepower increased 32 per cent, the number of lighting customers 43 per cent, power customers 44 per cent, sales of energy for lighting 72 per cent, for power 47 per cent, the connected lighting load 44 per cent and the connected power load 66 per cent.

CONNECTED LOAD AND SALES OF ENERGY, DENMARK

	No. of Meters in Thousands		Thousands of Lamps	Thousands of Motor Hp.	Energy Sales, Millions of Kw.-Hr.		
	Lighting	Power			Lighting	Power	Total
Two chief cities	217	10.7	2,880	105	39.1	51.4	90.5
Other urban centers	228	21.4	2,620	138	34.3	41.3	75.6
Regional stations	147	52.0	2,640	365	16.5	33.7	50.2
Rural	52	16.7	755	90	5.1	6.6	11.7
Total	644	100.8	8,895	698	95.0	133.0	228.0

ROCKLAND LIGHT & POWER FORMS VOTING TRUST.—Directors of the Rockland Light & Power Company have announced that they have deemed it advisable to form a stock trust agreement for the mutual protection of all the stockholders. The trustees named in the agreement are Charles H. Tenney, Edward M. Bradley, D. Edgar Manson, Alexander S. Burns, Jr., and Samuel A. York. The trust agreement authorizes the trustees to sell the deposited stock at $153.85 per share for the preferred and $200 per share for the common stock.

Canada's Monthly Output Is Close to Billion Mark

Electricity generated in central electric stations in Canada during July was greater than in the corresponding month of any previous year on record, according to a recent report by the Dominion Bureau of Statistics. In July this year the total output was 945,546,000 kw.-hr., compared with 903,795,000 kw.-hr. in July, 1926, and 796,669,000 kw.-hr. in July, 1925. Consumption is apparently keeping pace with the heavy installations being made in developing water power at many sites throughout the Dominion. In 1925 the monthly output ranged from 725,022,000 kw.-hr. to 931,093,000 kw.-hr. The low figure in 1926 was 843,289,000 and the high 1,053,019,000. This year the monthly total has already exceeded the billion kilowatt-hour mark in two months, January and March, in each case being about 100,000,000 kw.-hr. above the corresponding months

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Sept. 27	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4% com.—no par	110¼	83	111
Adirondack Pwr. & Lt.—7% pf.	110½	107	113½
Adirondack Pwr. & Lt.—8% pf.	115	112	116
Ala. Pwr., $7 cum. pf.—no par	111½	107	112½
Allis-Chalmers Mfg., 7% pf.	m111½	109	112½
Allis-Chalmers Mfg., 6% com.	113½	88	118¾
Aluminum Co. of Amer., com.	99½	67¼	105½
Aluminum Co. of Amer., 6% pf.	103½	101½	104½
Amer. & Foreign Pwr., pf. 25% pd.	m110	....	....
Amer. & Foreign Pwr., 7% pf.—no par	105½	86½	108
Amer. & Foreign Pwr., com.—no par.	30½	18¾	30½
Amer. Bosch Magneto, com.—no par	23½	13	26½
Amer. Brown Boveri Elec†	k 9	5½	39½
Amer. Brown Boveri Elec., pf. $7	k 49½	40	98
Amer. Gas & Elec., 6% pf.—no par	104	95½	101½
Amer. Gas & Elec., com.†—no par	116½	68¼	117½
Amer. Lt. & Trac., 6% pf.	114	113	126
Amer. Lt. & Trac., new com.	180½	164¾	186
Amer. Pwr. & Lt., 6% pf.	106	97½	106½
Amer. Pwr. & Lt., com.†—no par	70½	54	70½
Amer. Pub. Serv., 7% pf.	a 99	94	104
Amer. Pub. Serv., com.†	70	....	....
Amer. Pub. Utilities, 7% pfc. pf.	a 87½	73	88½
Amer. Pub. Utilities, 7% pr. pf.	a 87½	92	96
Amer. Pub. Utilities, com.	k 53	65	70
Amer. States Sec., A.	4½	2¼	4½
Amer. States Sec., B.	4¼	2¼	4¼
Amer. Superpwr., 6%pfc pf.—25	29	26¼	29½
Amer. Superpwr., 6% 1st pf.	l 98	....	....
Amer. Superpwr., Class A†—no par	41	27½	41
Amer. Superpwr., Class B†—no par	42	28¼	42
Amer. Wtr. Wks. & Elec., 7% pf.	m111½	104½	111¾
Amer. W. W. & E., com. new—no par	68	46	68
Anaconda Copper cap. $50	48	41¼	49½
Appalachian Electric Pwr., 7% pf.	104	100	105
Appalachian Elec. Pwr., com.	m 78	77	83
Arizona Pwr., 7% pf.	k 75	77	84½
Arizona Pwr., com.	m 20	....	....
Arkansas Pwr. & Lt. 7% pf.	104½	....	....
Assoc. Gas & Elec., $3.50—50	51	....	....
Assoc. Gas & Elec., pf.—$6—no par.	93	85	93
Assoc. G. & E., Class A, 10—no par.	42½	35	43½
BABCOCK & WILCOX, 7% com.	114	113	124
Binghamton L., H. & P., $6 pf.	98	93	100
Birmingham Elec., pf.—$7—no par.	107	105	109
Blackstone Valley G. & E., 6% pf.	106	103	105
Blackstone Valley Gas & Elec., 10% com.—50	142	98	154½
Blaw-Knox, com.†	t 95	70	95
Brasilian Trac., Lt. & pwr., com.†	f196	....	....
Broad River Pwr., 7% pf.	103½	97	103
Brooklyn Edison, 8% com.	180	148½	184½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	l 25½	....	..
Buffalo, Niagara & East. Pwr. com. $1—no par	l 35½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	97	96	99½
California Ry. & Pwr., 7% pf.	135	125	150
Carolina Pwr. & Lt., pf.—$7—no par	l109½	107	109½
Central & S.W. Util., $7 pf.—no par	a 96½	92¾	97½
Central & S.W. Util., pr.in.$7 pf.—no par	a101½	98½	104½
Central Ariz. Lt. & Pwr., 8% pf.	k 97	95	98
Central Ark. Ry. & Lt., 7% pf.	106	100	104
Central Ill. Pub. Serv., $6 pf.	a 93½	88½	95½
Central Ind. Pwr., 7% pf.	92	86	95
Central Pwr. & Lt., 7% pf.	101	100½	103
Central States Elec., 7% pf.	97	93	97
Central States Elec., com.†	m200	....	....
Century Elec., 6% com.	b126	114	128½
Chicago Fuse Mfg., com.—$2.50 no par	a 35	30	35½
Cincinnati Gas & Elec., 5% com.	q 99½	96½	100½
Cities Service, $6 pf—no par	l 91½	87	92½
Cities Service, pf. B—no par	l 8½	8	8½
Cities Service, pf. BB—no par	l 82½	80½	85
Cities Service, com.—20	l 49½	40½	58½
Cities Service, Bks. Shrs.—10	l 24½	22½	27
Clarion River Pwr., 8% pf.	95	....	....
Cleveland Elec. Illg., 6% pf.	110½	108	112
Cleveland Elec. Illg., 10% com.	322	285	330
Columbia Gas & Elec., 6% pf.	107	99½	107½
Columbia G. & E. com. $5—no par.	93½	82½	98½
Columbia Ry., Gas & Elec., 6% pf.	m 98	97	100
Columbus Elec. & Pwr., $2 com.—no par	68	....	....
Columbus Ry., Pwr. & Lt., 6% 1st pf.	104	98½	104
Columbus Ry., Pwr. & Lt., 6½% pf. B	101½	96	103½
Columbus Ry., P. & L., com.—no par	100	75	105
Commonwealth Edison, 8% com.	a155½	138	156½
Commonwealth Pwr., 6% pf.	101½	91½	101½
Commonw'th Pwr., $2, com.—no par	69	45½	69
Conn. Lt. & Pwr., 8% pf.	121	119	123
Conn. Lt. & Pwr., 7% pf.	117	112	118
Cons. Gas of N. Y., pf.	99½	93	100½
Cons. Gas of N. Y., com $5—no par.	118½	94	121½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	k107½	100	109½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e112½	110½	114½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e116½	112½	117
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e128	127	130½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par.	e 62½	51	63½
Consolidated Pwr. & Lt., 7% pf.	105	100	106
Consumers Pwr., 6% pf.	103	100	102
Consumers Pwr., 6.6% pf.	105	103	105½
Continental Gas & Elec., 8% pfc. pf.	107½	103	106½
Continental Gas & Elec., 7% pr. pf.	103	100	103
Conti. G. & E. com. $4.40—no par.	k250	210	225
Crocker Wheeler, com.†	25	30	38
Crocker Wheeler, 7% pf.	82	78	88
DALLAS PWR. & LT., 7% pf.	109	107	110½
Dayton Pwr. & Lt., 6% pf.	107	101	107
Detroit Edison, 8% com.	157	133½	160½
Dubilier Condenser, com.—no par.	4	2½	5½
Duquesne Lt., 7% pf.	116½	114½	116½
EASTERN NEW YORK UTIL., $7 pf.	107	102	104½
Eastern New York Util. com.	65	70	75
Eastern States Pwr., $7, com.	9	9	13
Eastern States Pwr., pf.	95	90	95
East. Tex. Elec., 7% pf.	106	106	108
Edison Elec. of Boston, $12 com.	d260	217	267
El Paso Elec., 7% pf.	109	105	107½
Elec. Bond & Share, 6% pf.	l109½	105½	110½
Elec. Bd. & Sh. Sec., com. $1—no par	l 79	67½	79½
Electric Household Util.†	a 13	11	15½
Elec. Investors, 6% pf.—no par	96	92	97
Elec. Investors, com.†—no par	41½	32¾	42½
Elec. Investors, 10% pd. receipts	m 15	....	....
Elec. Pwr. & Lt., ctfs. pf.	105½	96	106½
Elec. Pwr. & Lt., ctfs., 40% pd.	k116½	103½	116½
Elec. Pwr. & Lt., ctfs. full pd.	m114	108½	111¾
Elec. Pwr. & Lt., ctfs., com.—no par.	28½	16¼	28½
Elec. Refrig. cap.†	12½	12½	37½
Elec. Ry. Securities, com.—no par	6½	....	....
Elec. St. Battery com. $5.25—no par	73½	63½	79½
Elmira Wtr., Lt. & R.R., 7% pf.	103	99	101½
Emerson Elec., pf.	m109	107½	111
Empire Pwr., pfc.†	33	26	39
Engr. Pub. Serv., $7 pf.—no par	105½	93½	106½
Engr. Pub. Serv., com.—no par	34½	21½	36
Eureka Vacuum Cleaner, com. $4—no par	71½	50	77
FAIRBANKS MORSE, 7% pf.	k111	107½	112
F.-M., com.—$3—no par	33	32	43½
Federal Lt. & Trac., com. $1.40	42½	37½	47
Federal Lt. & Trac., $6 pf.—no par	99	91½	100
Ft. Worth Pwr. & Lt., 7% pf.	l111½	108	112
GALVESTON-HOUSTON ELEC. 6% pf.	72	68	72
Galveston-Houston Elec., com.	31	26	32
Gen. Elec., $3 com.—no par	134½	81	146¾
Gen. Elec., special—6%	11½	11	11½
Gen. Gas & Elec. (Del.) com. A. $1.50—no par	40½	34	47½
Gen. G. & E. (Del.) com. B—no par	m 45	35½	44½
Gen. G. & E. (Del.) pf. A. $8—no par	k117	113½	120
Gen. G. & E. (Del.) pf. A $7—no par	k110	100	110
Gen. G. & E. (Del.) pf. B $7	k102	96	105
Gen. Pub. Serv., $7 cum. pf., no par	k109	102	106
Gen. Pub. Serv., com., no par	15½	11½	15½
Ga. Lt., Pwr. & Rys., 6% pf.	94	87	96
Ga. Lt., Pwr., & Rys., com.	m 50	50	80
Ga. Ry. & Pwr., 8% pf.	k125	119	125
Ga. Ry. & Pwr., 7% pf.	k113½	106	110
Gt. Western Pwr., 7% pf.	k102½	....	....
IDAHO PWR., 7% pf.	109	103	109
Ill. No. Utilities, 6% pf.	m 96	92	97
Ill. Pwr. & Lt., 7% pf.	101	99	101½
Ingersoll Rand com. $8	k 88	88½	96½
Int. Combus. Engr., com. $2—no par	51½	43½	64
Int. Util., Class A—$3.50—no par.	k 43½	24	45½
Int. Utilities, Class B—no par.	6½	3	7½
Interstate Pwr., pf.—$7—no par.	95½	93	98
Interstate Pub. Serv., 7% pf.	94½	98	99½
Iowa Ry. & Lt., 7% pf.	98	97	99
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	104½	100	104½
Johns-Manville, com.†—no par	114½	55½	120½

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Sept. 24. *l*Bid price Wednesday, Sept. 28. *m*Latest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Sept. 27	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf.	$7 115¼	112	115¼
Kansas Gas & Elec., 7% pf.	*l*106¼	103	107
Kentucky Hydro-Elec., 7% pf.	*a* 98	94½	100
Kentucky Sec., 6% pf.	86	83	87
Kentucky Sec., 5% com.	109	110	115
Kentucky Utilities, 6% pf.	99½	95	98½
Keystone Pwr. & Lt., pf.	*m* 98	95	100
LACLEDE GAS LT., 12% com.	*k* 220	173½	267½
Lehigh Pwr. Sec., com.—no par.	20½	15	21½
Long Island Ltg., 7% pf.	111	107	112
Long Island Ltg., com.†—no par	152	139	153
Los Angeles Gas & Elec., 6% pf.	102	98	104½
Louisville Gas & Elec., cl. A. $1.75	26½	23½	27½
MAN. ELEC. SUPPLY, cap. $5—no par	53	49	132
Manila Elec., com.†—no par	*k* 49	40	50
Maytag Mfg., com. .50—no par	32	23½	34½
Memphis P. & L., pf.—$7—no par	108½	107	109
Metropolitan Ed., pf.—$6—no par	101	93	100
Metropolitan Ed., pf.—$7—no par	107	104	108
Metropolitan Ed., com. $5—no par	75	60	72
Middle West Utilities, 7% pf.	*a*113½	110½	113½
Middle West Util., 8% pr. lien	*a*120½	117½	122½
Middle West Util., com. $6—no par ex. div.	*a*113	108	117½
Midland Utilities, pr. ln. 6% pf.	*a* 95	92½	96
Midland Utilities, 7% pf. A	*a*102	96½	102½
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*102	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	98½	98	101½
Minn. Pwr. & Lt., 7% pf.	*l*106½	104	107
Miss. Pwr. & Lt., $8 pf.	*m*101	106	103
Miss. River Pwr., 6% pf.	102½	94	103
Miss. River Pwr., 3% com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	106	100	109
Mohawk Hudson Pwr., 2d pf.—$7—no par	110	98	112
Mohawk Hudson Pwr., com.—no par	31	20½	32½
Montana Pwr., 7% pf.	*m*106½	118½	106½
Montana Pwr., 5% com.	105½	81½	106½
Montreal Pwr., 7% com.	*f* 92½	....	....
Mountain States Pwr., 7% pf.	100	97	101
Mountain States pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	107	98	105
National Carbon, 8% pf.	*m*139	130½	139½
National Elec. Pwr., A†	*a* 24½	22	25½
National Lt., Ht. & Pwr., com.	24	....	....
National, Light, Ht. & Pwr., 5% pf.	70	....	....
National Pwr. & Lt., pf.—$7—no par	108	101	109½
National Pwr. & Lt., com.†—no par.	26½	19½	26½
National Pub. Serv., 7% pf.	*k* 98	93	100
National Pub. Serv., 7% pfc., pf.	113	108	115
National Pub. Serv., A com. $1.60—no par	22½	18½	24
National Pub. Serv., B com.—no par	*k* 18	14	20½
Nebraska Pwr., 7% pf.	*l*110	106	110
Nevada-Calif. Elec., com.	*k* 26	22	27
New Brunswick Pwr., 4% pf.	60	....	....
New Eng. Pub. Serv., pr. ln. pf. $7..	101	98½	101
New Eng. Pub. Serv., pf. $7	97	95	97½
New Orleans Pub. Serv.—7% pf.	103	103	105½
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	91	97
N. Y. Central Elec., 7% pf.	102½	101	104
Newport News & Hampton Ry., Gas & Elec., 5% com.	109	....	....
Newport News & Hampton Ry., Gas & Elec., 7% pf	109	....	....
Niagara Falls Pwr., 7% pf.—25....	*k* 28½	27½	29½
Niagara, Lock. & Ont. Pwr., 7% pf.	113½	112½	116
No. Amer., 6% pf.—50.	*k* 53½	50	55
No. Amer., com.—10	60½	45½	60½
No. Caro. Pub. Serv., pf.—$7—no par	101	93	102½
Northeastern Pwr., com.	19½	14½	20½
No. N. Y. Utilities, 7% pf.	106	103	109
No. Ohio Pwr., com.—no par.	17½	9½	17½
No. Ohio Trac. & Lt., 6% pf.	83	78	81
No. Ont. Lt. & Pwr., 6% pf.	*k* 91	84	95
No. Ont. Lt. & Pwr., 4% com.	72	73	78
No. States Pwr., (Del.) 7% pf.	106½	101	107½
No. States Pwr., (Del.) 8% com.	131½	109½	131½
No. Texas Elec., 6% pf.	62	65	70
No. Texas Elec., com.	25	27	36
OHIO BRASS, com. B $4—no par.	84	74	85½
Ohio Brass, 6% pf.	105	100	105
Ohio Pwr., 6% pf.	101	96	103
Ohio Pub. Serv., $6 pf.	98	95	96½
Ohio Pub. Serv., 7% pf.	105	103	109
Ohio River Edison, 7% pf.	107	103	109½
Oklahoma Gas & Elec., 7% pf.	101½	...	....
PACIFIC GAS & ELEC., 6% pf.	26½	24½	26½
Pacific Gas & Elec., 8% new com.	44½	31	45½
Pacific Pwr. & Lt., 7% pf.	*l*104½	102	104½
Penn Cent. Lt. & Pwr., $5 pf.—no par	*c* 77½	75½	77½
Penn-Ohio Edison, 7% pf.	103½	97½	104½
Penn-Ohio Elec., 7% pf.	*m*101½	98	100
Penn-Ohio Pwr. & Lt., 7% pf.	107½	94	109
Penn Pwr. & Lt.—$7—no par.	*l*109	107	109
Penn Wtr. & Pwr., 8% com., new.	*e* 63	47½	63
Phila. Co., 6% pf.—50.	*c* 53	49½	53½
Phila. Co., com.—50.	107½	85½	110
Phila. Elec., 8% com.—25.	*c* 56½	46½	58½
Portland Elec. Pwr., 7% pf.	100	97½	101
Portland Elec. Pwr., 6% pf.	80	78	83
Portland Elec. Pwr., 6% 2d pf.	65	55	70
Portland Elec. Pwr., com.	27	22	30
Potomac Elec. Pwr., 6% pf.	*l*110½	....	....
Pwr. Corp. of N. Y., com. $1—no par	*m* 79	....	....
Pwr. Sec., pf.—no par.	*k* 40½	28	43
Pwr. Sec., com.—no par.	*k* 11	5	8
Public Serv. of Colorado, 7% pf.	*l*102	99	102
Pub. Serv. of N. J., 6% pf.	*k*100½	98½	101½
Pub. Serv. of N. J., 8% pf.	130½	125	132
P. S. of N. J., $2 com.—no par.	46	32	46½
Pub. Serv. of No. Ill., 6% pf.	*a*106½	101½	106½
Pub. Serv. of No. Ill., 7% pf.	*a*117½	112	117½
P. S. of No. Ill., com. $8—no par	*a*142	140½	143
Pub. Serv. of No. Ill., $8 com.	*a*142	132	142
Pub. Serv. of Okla., 7% pr. ln.	*m*100	99	100½
Pub. Serv. Elec. & Gas, 6% pf	107½	102	108½
Puget Sound Pwr. & Lt., 7% pr. pf.	106½	103½	111
Puget Sound Pwr. & Lt., $6 pf.—no par.	88	....	....
Puget Sound Pwr. & Lt., com.	32½	28	35½
RADIO CORP. OF AMER., $3.50 pf.—50	*k* 53½	49	54½
Radio Corp. of Amer., com.—no par.	64½	41½	68½
Republic Ry. & Lt., pf.	*m*120	....	....
Republic Ry. & Lt., com.	*m*135	112	135
Rochester Gas & Elec. 6% pf. D.	*k*104½	101	103½
Rochester Gas & Elec., 7% pf. B	107½	105	107
Rochester Gas & Elec., 6% pf. C.	*k*104½	101½	103½
SAFETY CABLE, com. $4	67½	52½	74½
San Joaquin Lt. & Pwr., 7% pr. pf	106	105	108
St. Joseph Ry., L. H. & P., 5% pf.	72	70	73
Servel Corp.	75cts	52cts	10½
Sierra Pacific Elec., 2% com.	26½	24½	28½
Sioux City Gas & Elec., 7% pf.	104	99	104
Southeastern Pwr. & Lt., pf.—$7 no par	*l*107	....	....
Southeastern Pwr. & Lt., ptc. pf.	*k* 81	....	....
Southeastern Pwr. & Lt., com.—no par	37½	29½	38½
So. Calif. Edison, 8% pf.	39	36	40
So. Calif. Edison, 7% pf.	*k* 28	27	28½
So. Calif. Edison, 6% pf.	*k* 25½	24	27
So. Calif. Edison, 8% com.	40	31½	41
Southern Cities Utilities, 7% pf.	*k* 68	67	90½
Southern Cities Utilities, com. $4	*k* 32½	23½	42½
Southwestern Lt. & Pwr., A $3.	63	60	65
Southwestern Lt. & Pwr., B.	63	60	65
Southwestern Lt. & Pwr., $6 pf.	86	83	91½
Southwestern Pwr. & Lt., 7% pf.	*k*109	103	110½
Springfield (Mo.) Ry. & Lt., 7% pf.	102	95	102
Standard Gas & Elec., 8% pf.	64	57½	64½
Standard Gas & Elec., 7% pr. pf.	110	103	110
Standard G. & E., com. $3.50—no par	65½	54	65½
Standard Pwr. & Lt., 7% pf.	101	98	102½
Staten Island Edison, pf.—$6—no par	100	99	101
Superheater, $6 com.—no par	177	170	185
Syracuse Lighting, 7% pf.	105	103	107
Syracuse Lighting, 8% pf.	115½	....	....
Syracuse Lighting, 8% com.—no par	*m*300	....	....
TAMPA ELEC., com. $2	64	49	64½
Tenn. Elec. Pwr., 6% pf.	98	92	99
Tenn. Elec. Pwr., 7% pf.	107	103	109
Terre Haute, Ind. & East. Trac., 5% pf.	26	20	30
Terre Haute, Ind. & East. Trac., com	1	1	3
Tex. Pwr. & Lt., 7% pf.	*l*110½	106	110½
Tide Water Pwr., 8% pf.	107	105	110
Timken Roller Bear., com.—$4 no par	115½	78	142½
Toledo Edison, 8% pf.	114	115	118
Toledo Edison, 7% pf.	*l*107	102	107
Toledo Edison, 6% pf.	*k* 98½	95	97
Toledo Edison, 6% com.	98	....	....
Tri-City Ry. & Lt., 6% pf.	96½	96	99
UNITED GAS & ELEC., 6% pf.	101	98	102
United Gas & Elec., com.—no par.	*m* 57	....	....
United Gas & Elec. (N. J.) 5% pf.	72	70	73
United Gas Impr., 8% com.—50.	*c* 116½	89½	118½
United Lt. & Pwr., pf.—$4—no par.	55½	50½	57
United Lt. & Pwr., pf.—$6.50—no par.	*a* 95½	87	97½
United L. & P., com. A .48—no par.	14½	12½	15½
United L. & P., com. B .48—no par.	*k* 19	14	19½
Utah Pwr. & Lt., 7% pf.	*l*107	104	108½
Utica Gas & Elec., 7% pf.	105	105	106½
Utica Gas & Elec., 8% com.	200	....	....
Utilities Pwr. & Lt., 7% pf.	95½	93	100
Utilities Pwr. & Lt., com. A $2	31½	27	34
Utilities Pwr. & Lt., com. B $1—no par.	20	13½	21½
VERMONT HYDRO-ELEC., 7% pf.	99	95	100
Virginia Elec. & Pwr., 7% pf.	108	105	110
Virginian Pwr., 7% pf.	*k*108	....	....
Virginian Pwr., com.	75	....	....
WAGNER ELEC., 7% pf.	*b* 87½	68	90
Wagner Elec., com.—no par.	*b* 32½	18½	39½
Washington Ry. & Elec., 5% com.	*f*310	....	....
Washington Ry & Elec., 5% pf.	*f* 95	....	....
Washington Wtr. Pwr., 8% com.	160	136	182
West Penn Elec., 7% pf.	111½	102	112½
West Penn Elec., Cl. A $7.	107	97½	110
West Penn Pwr., 7% pf.	116	111	118
West Penn Pwr., 6% pf.	108½	100½	108½
West Virginia Lt., Ht. & Pwr., 7% pf.	92	94	96
West Va. Utilities, 7% pf.—50.	*m* 90	48	51½
Western Pwr., 7% pf.	*k*103	98	101½
Western States Gas & Elec., 7% pf.	*k*104	96	105
Western States Gas & Elec., com.	*m* 38	....	....
Westinghouse Elec. & Mfg., 8% com.—50	84½	67½	89½
Weston Elec. Instrument, Cl. A $2—no par ex.div.	*k* 31	30	34½
Weston Elec. Instrument, com.—no par.	*k* 11½	11	18½
Wheeling Elec., 6% pf.	102	95	104
Worthington Pump, 7% pf. A.	*k* 52	46	61½
Worthington Pump, 6% B.	*k* 42	40	54½
Worthington Pump, com.	*k* 33	20½	46
YALE & TOWNE com. $5—25.	*k* 81½	70½	84½

Stock Exchange: *a*Chicago, *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Sept. 24. *l*Bid price Wednesday, Sept. 28. *m*Latest quotations available. †Dividend rate variable.

of last year. With a monthly average so far in 1927 of 976,846,000 kw.-hr. and the heaviest consumption coming normally in the last three months of the year, it may be anticipated that this year's output will come very close to averaging a billion kilowatt-hours per month.

Of the total output of central electric stations in Canada for July, 931,362,000 kw.-hr. was generated by water power and only 14,284,000 kw.-hr. from fuel.

Energy Consumption in Germany

According to a statement contained in the last annual report of the Berlin electric supply corporation, the "Bewag," the average energy consumption in Germany in 1926 was approximately 180 kw.-hr. per capita. The corresponding figure for the United States, based on United States Geological Survey statistics, was 630 kw.-hr.

UNITED GAS & ELECTRIC PREFERRED DIVIDEND INCREASED.—Directors of the United Gas & Electric Corporation have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable Oct. 1 to holders of record Sept. 10. This rate compares with dividends at the rate of 6 per cent per annum paid from Sept. 30, 1925 to June 30, 1927 inclusive.

GERMAN GENERAL ELECTRIC TO INCREASE STOCK.—Directors of the German General Electric Company have called a meeting for Sept. 19, when approval will be asked for an increase in the company's ordinary share capital by 30,000,000 marks, making the total 150,000,000 marks.

Importations from Canada 1,500,000,000 Kw.-Hr.

The following table containing data published by the Department of Trade and Commerce of Canada shows, in kilowatt-hours, the amount of electricity exported to the United States from Canada and imported to Canada in 1926 and the first three months of 1927.

	Exports		Imports	
Month	1926	1927	1926	1927
Jan.	115,793,000	130,894,000	297,000	281,000
Feb.	101,155,000	121,829,000	282,000	266,000
Mar.	110,911,000	133,702,000	310,000	446,000
April.	115,696,000	.....	260,000	.....
May.	119,398,000	.....	268,000	.....
June.	127,351,000	.....	249,000	.....
July.	132,225,000	.....	258,000	.....
Aug.	142,857,000	.....	256,000	.....
Sept.	146,678,000	.....	252,000	.....
Oct.	144,160,000	.....	265,000	.....
Nov.	119,381,000	.....	245,000	.....
Dec.	127,568,000	.....	288,000	.....
Yearly total	1,503,173,000	.....	3,230,000	.....

Business News and Market Conditions

Upward Trend Shown in Electrical Exports

United States exports of electrical equipment have shown a gain for the first seven months of 1927. Exports for that period amount to $57,006,694, an increase of $994,774 over last year, according to the electrical equipment division of the Department of Commerce. July shipments were valued at $8,536,610, a gain of $584,546 over the same month last year, and $1,023,940 more than for June. The larger increases over last year were for light equipment, although steam turbo-generator sets and accessories and parts for generators showed substantial gains. The largest increase was recorded for insulated copper wire and cable. Exports of radio apparatus during July, with the exception of transmitting sets and parts, showed increases, receiving sets showing the largest individual gain, $56,161—from 3,312, valued at $128,918, to 5,228, valued at $185,079. The value of receiving-set components rose $37,805 to $167,768 and receiving set accessories from $32,322 to $159,966.

Industrial Activity in California

A feature of the increasing industrial activity in California has been the electrification this year of three large lumber plants. These are respectively owned by the Pacific Lumber Company of Scotia, the Westwood Lumber Company of Westwood and the Bayside Redwood Company at Eureka, the first job being a General Electric installation, while the other plants were furnished with equipment by the Westinghouse Electric & Manufacturing Company. The character of the industry necessitated special attention to the safety factor, to high resistance rotors for frequent abnormal loads, to unhampered mill production right through the change and to isolation of possible breakdowns. The Pacific Lumber installation cost about $140,000 and covered a 5,000-kw., 2,300-volt turbo-generator, a 400-kw. transformer, a switchboard of 20 panels and 140 assorted motors up to 200 hp. in size; the Bayside installation included 64 motors from 5 hp. to 250 hp. and an eight-panel control switchboard, and the Westwood installation, which cost about $125,000, was featured by the electrification of an 18-mile logging line, neces-

Value and Destination of Electrical Exports for July, 1927, Compared with Corresponding Month in 1926

(Issued by Bureau of Foreign and Domestic Commerce)

Articles	July 1926	July 1927
Generators:		
Direct-current:		
Under 500 kw.	$79,033	$61,949
500 kw. and over	130,791	26,472
Alternating-current:		
Under 2,000 kva.	17,803	22,784
2,000 kva. and over	128,097	96,910
Steam turbo-generator sets	47,348	137,160
Accessories and parts for generators	65,588	157,740
Self-contained lighting outfits	88,429	111,421
Batteries:		
Flashlight batteries	129,715	188,164
Other primary batteries	212,669	291,098
Storage batteries	258,517	297,749
Transforming or converting apparatus:		
Power transformers	211,108	60,082
Other transformers	124,082	75,660
Rectifiers, double - current and motor - generators, dynamotors, synchronous and other converters	63,115	85,695
Transmission and distribution apparatus:		
Switchboard panels, except telephone	71,678	113,241
Switches and circuit breakers over 10 amp.	283,332	140,705
Fuses and fuse blocks	36,583	26,045
Watt-hour and other measuring meters	56,710	22,928
Volt, watt and ampere meters and other recording, indicating and testing apparatus	154,593	140,396
Lightning arresters, choke coils, reactors and other protective devices	49,051	57,841
Motors, starters and controllers:		
Motors, under 1 hp.	169,349	301,669
Stationary motors:		
1 to 200 hp.	$313,834	$227,553
Over 200 hp.	75,441	80,390
Railway motors	127,895	146,878
Electric locomotives:		
Railway	.....	.....
Mining and industrial	19,518	51,469
Starting and controlling equipment for:		
Industrial motors	129,958	72,508
Electric railway and vehicle motors	25,034	21,767
Portable electric tools	53,868	66,518
Accessories and parts for motors	219,890	238,167
Electric appliances:		
Electric fans	78,844	120,823
Electric lamps:		
Metal filament	161,771	132,131
Other electric lamps	19,575	31,554
Flashlights	166,545	201,012
Searchlights and projectors	50,070	66,619
Motor-driven household devices	127,189	166,534
Domestic heating and cooking devices	115,876	143,340
Industrial electric furnaces and ovens	25,277	41,134
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries, etc.	126,241	116,453
Signal and communication devices:		
Radio apparatus:		
Transmitting sets and parts	35,239	20,377
Receiving sets	128,918	185,079
Tubes	79,978	86,190
Receiving-set components	129,963	167,768
Receiving-set accessories	127,644	159,966
Telegraph apparatus	114,162	34,338
Telephone apparatus:		
Telephone instruments	54,837	27,634
Telephone switchboards	149,790	113,502
Other telephone equipment	$220,923	$156,412
Railway signals, switches and attachments	34,372	113,590
Bells, buzzers, annunciators and alarms	30,472	17,399
Other electric apparatus:		
Spark plugs, magnetos and other ignition apparatus	172,834	172,932
Insulating material	102,226	110,996
Metal conduit, outlet and switch boxes	113,510	74,826
Sockets, receptacles and lighting switches	140,697	133,615
Electric lighting fixtures, interior and street	117,884	131,079
Other wiring supplies and line materials	84,854	216,399
Other electrical apparatus not elsewhere stated	660,783	587,243
Rubber and friction tape	38,972	38,440
Globes and shades for lighting fixtures	45,545	57,078
Electrical glassware except for lighting	28,901	29,647
Electrical porcelain:		
For less than 6,600 volts	67,801	37,748
For 6,600 volts and over	65,856	82,877
Carbons, carbon brushes and electrodes:		
Electrodes for electric furnaces	111,422	104,838
Other carbon products	121,608	112,968
Insulated wire and cable (iron and steel)	34,594	15,651
Copppr, bare wire	331,375	257,737
Copper, insulated wire and cable	392,487	577,872
Refrigeration sets up to 1 ton capacity	.....	371,850
Total	$7,952,064	$8,536,610

DESTINATION OF ELECTRICAL EXPORTS

Country of Destination	July, 1927
EUROPE	$1,597,016
Belgium	49,013
France	138,333
Germany	82,890
Italy	75,304
Netherlands	64,544
Spain	140,019
United Kingdom	660,877
Other countries	386,036
WESTERN HEMISPHERE	$4,747,693
Canada	1,581,323
Mexico	408,725
Cuba	450,932
Argentina	616,744
Brazil	737,027
Chile	196,412
Colombia	197,056
Peru	122,232
Venezuela	69,106
Other countries	368,136
ASIA, AFRICA AND OCEANIA	$2,191,901
British India	225,089
China	105,308
Japan	454,931
Philippine Islands	148,861
Australia	690,170
New Zealand	190,877
British South Africa	141,810
Other countries	234,855

sitating two 60-ton, 1,000-kw., 1,500-volt locomotives and the needful automatic substations and other material.

Pacific Coast prices on virtually all jobbing lines have been affected because of recent freight rate increases by intercoastal steamship lines. These lines are grouped as A, B or C lines, the A lines carrying passengers as well as freight or running on a more frequent and faster schedule. The increases range from 25 per cent to 100 per cent, and most of them were effective on Aug. 1, the remainder, including wire, strand and schedule material, on Oct. 1.

Canada Apparently Increasing Battery Production

Canadian motor cars are being equipped with made-in-Canada storage batteries to a much greater extent than formerly, it would appear from a report on the production of batteries recently prepared by the Dominion Bureau of Statistics. In 1926 approximately 87,000 more storage batteries for use in automobile and internal combustion engines were manufactured in Canada than in the preceding year, the total being 324,405, valued at $3,458,846. There was also an increase of more than 4,000,000 in the number of dry cells manufactured, these totaling 30,990,577. In addition the battery industry produced 49,406 "A" and "B" type storage batteries for radio use. The 21 plants in Canada manufacturing storage or dry-cell batteries had a capital investment of $7,519,866.

Imports of dry cells and storage batteries into Canada during 1926 totaled $908,904 in value and included 39,233 storage batteries, worth $773,529. Exports are not shown separately in the trade report classification.

National Census of Stocks Under Consideration

Such great interest has been aroused in the sample censuses of distribution taken in seventeen cities this year that the National Committee on Distribution will be called together early in November to consider whether Congress shall be asked for an authorization for a complete national census of wholesale and retail sales, stocks, turnover, costs of merchandising and other factors. In making this known Secretary of Commerce Hoover, who has been deeply interested in the subject for several years, pointed out that while business men generally appeared to believe there is much valuable information in the sample censuses made public for Baltimore, Syracuse, Denver and Fargo, this work has been done mainly by volunteers supplied by local organizations, and that a complete national census of distribution by the Census Bureau through its own agents naturally would be more comprehensive.

A majority of the members of the national committee now appear to believe that a complete census of distribution every five years would be sufficient, although the original proposal was for a census every two years, coincident with the census of manufacturers. Secretary Hoover said that supplementary work might be done by local communities or trade associations whenever desired, with the national census as a basis. Owen D. Young is chairman of the national committee.

Market Conditions

BUSINESS continues at about the same rate in the electrical industry. A little more activity is reported in some sections and a large number of inquiries are in the market. Conditions in the industry appear to be less a question of volume of business and more a matter of keen competition and profits below previous levels. Leaders of the industry all express an optimistic opinion regarding the sales for the rest of the year. This belief is backed up by a sound credit situation and satisfactory crops in most lines. It is probable that good business will continue for some time with severe competition and an intensive sales effort on the part of manufacturers.

In New England active buying is reported and sales of power equipment have been good. Orders for about $125,000 worth of power apparatus and control equipment are expected to be placed at an early date by a wire plant in Worcester. Improvement is noted in the sales of apparatus to central-station companies in the New York district. Inquiries are good in virtually all lines. An order for at least ten electric locomotives is expected to be placed during the next few days. Central-station companies are active buyers in the Southeast. A South Carolina power company placed an order for $100,000 worth of power transformers. Merchandising activities continue brisk, one of the larger companies having closed a refrigerator campaign in which units totaling $127,000 were sold in the two weeks period. In the St. Louis district sales have shown a tendency to decrease. An order for $2,000,000 worth of transformers, reactors and switching equipment was placed in the Middle West. Improvement of business conditions in that territory is steady but small. On the Pacific Coast a large order was placed for electric propulsion ferryboat equipment valued at $70,000. Sales to power companies are good and industrial plants are buying in fair volume.

Metal Markets Dull—Price Concessions Made

Producers of the non-ferrous metals can find little ground for optimism in the market report. Sales of all metals have been meager, and the prices for all

Delinquent Electrical Accounts

(Data Supplied by National Electrical Credit Association)

NUMBER OF ACCOUNTS REPORTED

Division	August 1926	August 1927	Per Cent Increase or Decrease	Eight Months 1926	Eight Months 1927	Per Cent Increase or Decrease
New York	280	295	+5.35	3,019	2,631	—12.8
Middle and Southern Atlantic	208	146	—27.7	1,567	1,340	—14.5
New England	91	147	+61.5	721	1,249	+73.2
Pacific Coast	15	22	+46.6	193	139	—29.8
Central	798	975	+22.2	7,178	7,505	+4.56
Total	1,386	1,585	+14.4	12,683	12,864	+1.43

TOTAL AMOUNTS REPORTED

	August 1926	August 1927	Per Cent Increase or Decrease	Eight Months 1926	Eight Months 1927	Per Cent Increase or Decrease
New York	$39,624	$43,216	+9.07	$441,399	$420,371	—4.76
Middle and Southern Atlantic	24,381	15,984	—34.4	172,845	163,039	—6.25
New England	8,684	22,424	+158.2	67,246	143,839	+107.8
Pacific Coast	2,858	1,472	—48.5	34,302	17,768	—48.2
Central	83,238	83,587	+.42	777,162	843,702	+8.56
Total	$158,765	$166,683	+4.28	$1,494,954	$1,587,767	+6.21

AVERAGE AMOUNTS

	August 1926	August 1927	Eight Months 1926	Eight Months 1927
New York	$141	$146	$1,163	$1,289
Middle and Southern Atlantic	120	109	873	967
New England	95	152	781	923
Pacific Coast	190	67	1,293	1,307
Central	104	86	867	804

Note.—The sharp increase in accounts reported by the New England Division is owing more to increased association activity in that section than to adverse economic conditions.

NEW YORK METAL MARKET PRICES

	Sept. 21, 1927 Cents per Pound	Sept. 28, 1927 Cents per Pound
Copper electrolytic	13.20—13.25	13
Lead, Am. S. & R. price	6¼	6¼
Antimony	10¾—11	10¾
Nickel, ingot	35	35
Zinc spots	6.55	6.425–6.45
Tin, Straits	60¼	58.625
Aluminum, 99 per cent.	26	26

Base copper price Sept. 28, 1927, 15¼ cents.

the more important ones are less than they were a week ago. The most that can be said for the lead market is that the American Smelting & Refining Company is holding firm at its contract price of 6.25 cents despite a quiet demand and continued reductions abroad. Less zinc has been sold than in any week for over a year.

Improved Sales Noted in New York District

Some improvement in the sales of electrical apparatus to public utility companies is noted in the New York district, although some lines continue quiet. The demand for transformers is fair, and there is an increase in activity of poles and cross-arms. Inquiries are good in virtually all lines, and manufacturers generally are optimistic that a good market will prevail during the latter quarter of the year. Railroad electrification is progressing and orders for at least ten locomotives are expected to be placed during the next few days. Sales of small motors to industrial buyers continues good with a spotty demand for machines of the larger sizes. Jobbers report a general improvement in the demand.

Active Buying Reported in New England District

Activity in sales of power equipment has been quite marked in the New England district. One manufacturer reports an order amounting to about $200,000 for three 6,000-kw. turbo-generator units and accessories for a Virginian plant and a number of interesting inquiries for small units. Central-station supplies are selling well and a number of orders are reported, one, amounting to about $25,000, consisting of panelboards and control equipment, and another for insulators and accessories amounting to $3,000. Other orders for smaller lots attest an encouraging trend in the demand for this equipment. Pole-line hardware, wire and cross arm sales are also active. Plans for a $35,000,000 dam on the Connecticut River at Dalton, N. H., have been outlined.

The demand for small motors is normal. One manufacturer records a slight increase in sales owing to oil-burning equipment manufacturers entering the market and points to one order recently placed by a southern New England plant for over $10,000 worth. Commercial electric lighting is increasing in activity and plans are completed for store-lighting campaigns in the district. Range sales are active and encouraging campaign results are reported from Providence, R. I. Orders amounting to about $125,000, consisting of power apparatus and control equipment, will soon be placed by the American Steel & Wire Company for its Worcester plant.

Utility Companies Active Buyers in Southeast

The largest central-station order recorded in the Southeast covered power transformers amounting to over $100,000 and was placed by a South Carolina company. Another power company order for copper wire amounted to $8,100, while another order for the same material called for $3,300 worth. One company's miscellaneous wire and cable orders during the past ten days amounted to $3,200 and its orders for watt-hour meters to $1,400. Small power and distribution transformers continue in good demand, one company ordering distribution transformers costing $6,200. Pole-line materials are in active demand in some sections of the territory, one of the smaller central-station companies ordering $1,000 worth of pole-line materials, while one of the larger companies ordered creosoted pine poles totaling $4,300. Another central-station order called for small disconnect switches amounting to $3,100.

Power companies' merchandising activities continue brisk, one of the larger companies having closed a refrigerator campaign in which units totaling $127,000 were sold in the two weeks period. Another company has just closed an electric range campaign in which 362 stoves were sold, and another range campaign netted 150 sales in several small towns of one company. Virtually all lines of household devices are selling in good volume with fall prospects excellent. While there is a considerable amount of industrial business pending, no important contracts were closed and other than orders for small-sized motors, the only order reported was from Alabama for $5,000 worth of inside wiring materials for a textile mill.

Sales Show Tendency to Decrease in St. Louis

Business in the St. Louis district has shown a tendency to slow down. One manufacturer reports the sale of an eight-thousand-dollar switchboard for shipment South, and feeder regulators, costing $4,000, for a local company. Two companies making electric signs report this season's business well above that of last year and say that the outlook for future business is excellent. Wire and cable manufacturers say that there is a temporary lull in the demand at the moment, but plenty of inquiries to figure on. Jobbers are shipping a good volume of electric appliances, with stoves and heaters in the lead. There is very little activity in new building construction, but several fair-sized jobs for rewiring old buildings have been closed.

Large Apparatus Order Placed in Middle West

Little change in conditions is seen in the Middle West. It is generally admitted that business is improving steadily, although the improvement is small. Reports from agricultural districts indicate good crops and many lines of industry show improvement. Industrial activity is more pronounced with a greater number of persons employed and an optimistic attitude is in evidence. The various utility companies are busy with extension work, particularly overhead extensions. Among the interesting items ordered were transformers, reactors, switchboards and switching equipment valued at $2,000,000, two economizers complete with appurtenances, six automatic belt feed coal scales, two 100,000-gal. elevated water tanks, and eight 2½-in. blow-off valves and spare parts for coal-handling equipment valued at $10,000.

Jobbers report a seasonal increase of business. Appliances continue in good demand with considerable holiday purchasing under way. Active campaigns for better ventilation continue to result in volume sales of ventilation equipment. Small-motor sales have been quite substantial with a good demand for vacuum cleaners. Prices remain generally firm.

Electric Ferryboat Equipment Ordered on Pacific Coast

An order placed by a San Francisco Bay ferryboat company on the Pacific Coast covers electric propulsion equipment, valued at $70,000. Another order placed in that territory calls for a turbo-generator unit, valued at $30,000, complete with a six-thousand-dollar switch board for a Hawaiian Island sugar plantation.

Varied small-motor business has been good and includes 300 washing-machine motors, valued at $4,000 for an East Bay manufacturer; also 51 ½-hp. and ¼-hp. motors for switch-operating machinery as well as 80 1/30-hp. and 100 ½-hp. motors, valued at $3,000, for a manufacturer of calculating machines. Power-company orders include one carload of 11,000-volt and 22,000-volt pin-type insulators, valued at $8,500, and two heavy substation circuit breakers for 15,000-volt service, valued at $6,500. Power-company inquiries include a good quantity of pole line hardware. Certain wiring devices, such as brass-shell sockets and single old-brass plates have decreased sharply in price. Fuse plugs have decreased about 10 per cent.

A twenty-five-thousand-dollar substation will be installed in Wenatchee, Wash., early next year by the Puget Sound Power & Light Company in connection with the electrification of the Great Northern Railway. The Puget Sound company recently purchased two 2,000-kw. transformers and a 400-amp. oil circuit breaker for its outdoor substation in Olympia and is planning a similar installation in Bellingham. Sales reported include a 2,000-kw. transformer

for use with an electric furnace to a car and foundry company, $15,000 worth of motors and miscellaneous equipment to a lumber company in Idaho and 25 1-hp. motors for eastern Washington orchards. The sale of several thousand power-line insulators to two separate central-station companies has also been reported. The city of Seattle will open bids on Oct. 7 for two 3,000-kw. transformers and is planning the expenditure of $1,000,000 for ornamental lighting installations in the downtown districts under a local improvement plan. A material increase has been noted in the sales of ranges, electrical heating devices and electric tableware.

Activities of the Trade

Splitdorf-Bethlehem Buys Perfection Appliance

The purchase of the Perfection Appliance Company of Detroit, manufacturer of the Perfection electric ironer, by the Splitdorf-Bethlehem Electrical Company, Newark, N. J., has been announced by Walter Rautenstrauch, president of the Splitdorf-Bethlehem company. Thomas J. Arbron, former president of the Perfection Appliance Company, joins the Splitdorf organization as executive manager of the subsidiary appliance company. The Splitdorf company states that new merchandising plans to be announced soon are being formulated along the aggressive lines followed by successful manufacturers of other appliances. The company officials express the opinion that the electric ironer is about to take equal prominence with electric washers, vacuum cleaners and other appliances now in more general use.

General Electric Completes Large Testing Pit

A pit which will permit the testing of the largest pieces of revolving machinery at runaway speeds with safety to the operators has just been completed at the Schenectady works of the General Electric Company. This pit has been built for the purpose of running double-speed tests on the rotors of waterwheel generators, from the smallest size up to machines 40 ft. in diameter and weighing as much as 500 tons. The pit is a circular chamber with a depth of 30 ft., surrounded by two concentric walls of heavily reinforced concrete, between which there is a cushion of sand. Over the top is placed a cover 8 ft. thick, of reinforced concrete and steel plate, and around the rim two ring girders each 2½ ft. deep. The pit is housed in a large brick and steel building, placed in a field a quarter of a mile from the nearest factory building.

Aside from the safety provisions of the new high-speed pit, the design includes modern arrangements for the testing of rotors. At the bottom of the pit is located a large vertical roller bearing capable of sustaining the weight of the largest rotor to be built. On the cover slab at the top a bed plate is provided for the installation of electric driving motors ranging from 1,000 hp. to 3,000 hp., which will be necessary in bringing the rotors up to the high speeds required. An observation building has been erected 300 ft. from the pit and connected with it by electric cables so that control of the motors is under the direction of the test engineers at all times. Into this building also are run the circuits which will enable the engineers to read the speed of the rotor and to obtain either visual or photographic records of the amount of its vibration. A telephonic headset is also provided, connecting with a microphone located in the pit, so that the operator can tell by the sound whether the rotor is behaving properly.

Combustion Engineering Gets Large Contract

George E. Learnard, president of the International Combustion Engineering Corporation, New York, announces the closing of a contract by its subsidiary, the Combustion Engineering Corporation of New York, with the Kansas City Power & Light Company for two complete steam generating units for the Northeast station. Each of these units will deliver 250,000 lb. of steam per hour continuously. The boilers are designed for 1,400 lb. pressure. The contract includes the "Lopulco" system for burning pulverized fuel, water-cooled furnaces, economizers, air preheaters and superheaters. During August the Combustion company was also awarded a contract by the Kansas City company for three complete steam generating units for the Grand Avenue station. These units have a total capacity of 225,000 lb. of steam complete with stokers, water-cooled furnaces, economizers and air preheaters and were designed to operate at 700 lb. pressure.

THE P. A. GEIER COMPANY, Cleveland, manufacturer of Royal electric cleaners, on Sept. 7 held an executive sales conference of the twenty-two senior representatives who are the key men of its sales organization. Frank J. Gottron, president, announced that, despite heavy development expense and increases in personnel, the company's dividend rate of 12 per cent per annum was being maintained. Walter B. Fulghum, vice-president in charge of sales, reported that sales so far in 1927 are substantially ahead of those for the similar period last year.

THE AMERICAN BROWN BOVERI ELECTRIC CORPORATION reports for the quarter ended June 30, 1927, a net loss of $45,587 after the deduction of depreciation, interest, etc. For the six months ended June 30 the net loss amounted to $359,297.

THE BLUE BIRD APPLIANCE CORPORATION, Star Building, St. Louis, announces that it is now offering a new electric clothes washer of the agitator type.

THE AMTORG TRADING CORPORATION, 165 Broadway, New York, announces that it will purchase for the Soviet government in the next few months American hydro-electric equipment amounting to about $5,000,000.

THE AUTOMATIC ELECTRIC HEATER COMPANY, 1505 Race Street, Philadelphia, has placed on the market the "Sun-Electric" water heater, which utilizes the heat rays of the sun in combination with electric heating elements.

THE OHIO BRASS COMPANY, Mansfield, Ohio, announces that George N. Brown, formerly vice-president and sales manager of the Pittsburgh Transformer Company, has joined the organization as manager of high-tension sales.

THE INTERNATIONAL GENERAL ELECTRIC COMPANY has assigned Loren Emery, formerly merchandise sales manager, to the executive department for special duties in Mexico. R. A. Rowlands succeeds Mr. Emery as merchandise sales manager.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is now building at its South Philadelphia works an oil-electric car which will develop 300 hp. and attain a speed of 60 miles per hour. The car is being built for the Canadian National Railways.

THE PARR ELECTRIC EXPORT CORPORATION, New York City, has been appointed export sales manager for the line of fish wire made by the Rapid Spring Company, Pittsburgh, Pa.

THE ROME WIRE COMPANY, Rome, N. Y., announces that its Boston office, formerly at 80 Boylston Street, is now at 156 Purchase Street, where a warehouse and office are maintained with Alva D. Stein as manager.

THE AUTOVENT FAN & BLOWER COMPANY, 1805 North Kostner Avenue, Chicago, recently gave a house-warming party at its new plant at the above address. An inspection of the new plant was included.

THE ELECTRICAL PRODUCTS CORPORATION of Arizona at its annual stockholders' meeting held in Phoenix, Ariz., elected Morris B. Miller, son of John B. Miller, president of the Southern California Edison Company, to membership on the board of directors to succeed W. L. Stewart, president of the Union

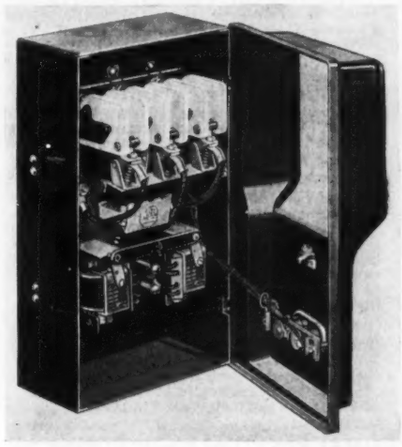
Oil Company of California. All other directors were re-elected. The new board consists of Paul D. Howse, John B. Miller, John W. Harris, Otto L. Little, G. I. Cochran, W. I. Hollingsworth, W. T. P. Hollingsworth, M. M. Kaufman and Morris B. Miller. The Electrical Products Corporation, a holding company, has exclusive license to manufacture and operate Neon electric-tube signs in the eleven Far-Western states, holding its franchise from Claude Neon Lights, Inc., of New York. The company owns all the stock of operating subsidiaries, incorporated in California, Washington and Oregon.

New Equipment Available

Push Button Starters

A complete line of alternating-current and direct-current push button starters ranging from ¼ hp. to 10 hp., 220 volts direct current and to 15 hp., 550 volts alternating current has been designed by the Allen-Bradley Company, Milwaukee. This line of starters is said by the manufacturer to give complete protection to operator, motor and machinery. Both the alternating-current and direct-current switches of similar rating have the same external dimensions. The covers on all starters swing to the side and can be locked.

Both switches are made in three forms. Form 1, shown in the illustration, has the "Start" and "Stop" push buttons mounted in the cover, form 2 is designed for operation with outside push button, float switch, etc., and



STARTER FOR ALTERNATING-CURRENT SERVICE WITH PUSH BUTTONS MOUNTED IN COVER

form 3 has a lever on the cover giving two-way control, both manual and automatic. The alternating-current starters give protection against overload, no-voltage and single phase operation. An outside reset lever permits resetting of the inducto-therm relays. Arc shields are used on all switches and magnetic blow-outs on the larger sizes of both alternating-current and direct-current switches. The direct-current starters give positive starting and no-voltage and overload protection. A special graphite compression resistor is used for acceleration until all resistance is cut out at full speed. Resistotherm relays provide overload protection.

AUTOMATIC WIRE CUTTING AND STRIPPING MACHINE.—An automatic machine which measures wires into lengths, cuts them off and simultaneously strips the insulation from both ends, has been developed by the Artos Engineering Company, 69 Wisconsin Street, Milwaukee. The machine is adjustable, both in regard to cutting length, stripping length and size of wire and has a capacity of 3,600 pieces cut and stripped per minute.

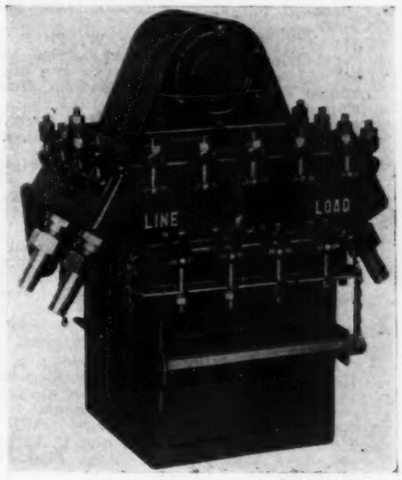
Automatic Reclosing Equipment

The type "T" automatic reclosing equipment, which employs the type "MI" reclosing mechanism, has been placed on the market by the Automatic Switch Company, 517 East Larned Street, Detroit. The type "T" equipment is said by the manufacturer to be a compact unit, housing the circuit breaker, reclosing mechanism, instrument transformers and, when desired, watt-hour meter and relay equipment. To place the apparatus in operation it is only necessary to fill the circuit breaker tank with oil and make the external electrical connections. The equipment is provided with removable sides to permit ready accessibility for inspection purposes. It is suitable for either platform or ground mounting.

PRESET THEATER LIGHTING CONTROL BOARD.—A preset theater lighting control board, by means of which a number of lighting scenes in a theater may be preset in advance and operated in any sequence from master control switches at various points, is announced by the General Electric Company. The operation may be controlled at the board on the stage level or from one or more distant points. The design consists of a floor-mounted, safety-type dimmer bank at the stage level, each dimmer being operable by an individual lever, or groups of dimmers may be operated by color master levers. In addition, any or all dimmers on the entire board may be operated through a grand master, slow-motion, cross-control wheel. This makes it possible to dim some of the groups and to brighten others with one movement. Immediately above each individual dimmer handle is mounted the control unit for the electrically operated contactor. On the contactor board is mounted standard industrial type contactors and fuse cutouts. This board is installed below the stage level in a fire and sound-proof room.

Subway-Type Time Switch

A subway-type Sauter time switch now being marketed by R. W. Cramer & Company, Inc., 136 Liberty Street, New York, has a rating of 25 amp., at 2,300 or 4,600 volts. The switch is of the double-pole type. The housing is cast in three pieces. The cover bolts on one side are so arranged that they act as a hinge. Inspection of the timing piece and the operation of the blocking lever is done through a small hand hole in front of the clock. Rubber gasketing is used throughout. Each housing is furnished with a breather-pipe entrance into which such a pipe with a check valve on it may be inserted. Disconnecting type wiping sleeves are a part of the standard equipment. This allows setting of the clock prior to transportation and also installation without opening the housing.



DOUBLE-POLE SUBWAY TIME SWITCH FOR USE ON DIRECT OR ALTERNATING CURRENT OF ANY COMMERCIAL FREQUENCY

A 50 volt-amp., 2,300-4,600/115-230-volt transformer is connected across the line terminals of the switch and is used to furnish energy for the motor which winds the clock and operates the switch contacts. The remainder of the switch is the standard motor-wound, motor-operated primary voltage Sauter time switch with astronomic dial, consisting of three units, the clock, the motor and the contacts. The time piece of this switch is the Sauter escapement type clock. In the Sauter time switch each action is controlled by a pin placed at a different distance from the center of rotation of the clock dial; hence it is impossible for a Sauter switch to get out of step with its operating schedule. The motor which winds the clock and operates the contacts is of the series type, 115/230 volts, and will work on any commercial frequency or on direct current without change. The contacts are of the brush type equipped with arcing tips and are oil-immersed.

Electrical Patents

Announced by U. S. Patent Office

(Issued Sept. 6, 1927)

1,641,604. SOLDER IRON; J. M. Russel, Dayton, Ohio. App. filed March 18, 1924. With provision of means for feeding solder pellets which are contained in a storage chamber to the solder tip or end of the iron.

1,641,627. COUPLING FOR WIRES, ETC.: C. H. Ericson, Boston, Mass. App. filed July 27, 1926.

1,642,629. THERAPEUTIC LAMP; N. E. Goodrich, Battle Creek, Mich. App. filed July 29, 1925.

1,641,643. QUICK-ACTING MECHANISM FOR TIME RELAYS; W. H. Petersen, Ludvika, Sweden. App. filed Jan. 11, 1923.

1,641,644. DYNAMO-ELECTRIC MACHINE AND WINDING THEREFOR; W. H. Powell, Wauwatosa, Wis. App. filed May 16, 1924. In a commutator-type multipolar machine having a slotted armature, the number of slots per pole being an integer, means for equalizing the currents in the armature winding, including a lap-type winding and a wave-type winding both connected to the commutator, the coils of both windings being of equal slot pitch and each commutator segment having connected thereto two pairs of coils, the respective coils of each pair being disposed to generate substantially equal emfs.

1,641,647. LIMIT SWITCH; W. D. Smith, New Orleans, La. App. filed Oct. 25, 1926.

1,641,654. METHOD AND MEANS FOR MEASURING VOLT-AMPERES; J. Yuyama, Omori, Japan. App. filed Oct. 24, 1925.

1,641,658. PAPER-BREAK DETECTOR SWITCH; H. Berglund, Brooklyn, N. Y. App. filed May 13, 1922. For opening the control circuit of the driving motor of a printing press.

1,641,659. AUTO TRANSFORMER; F. F. Brand, Pittsfield, Mass. App. filed Feb. 19, 1926. In which the common and series sections of its winding are closely coupled to avoid high reactance, the turns or coils of the winding being distributed along the core substantially in the order of increasing voltage, so that the voltage and therefore the insulation necessary between adjacent turns or coils is a minimum.

1,641,679. REGULATING APPARATUS; A. W. Hull, Schenectady, N. Y. App. filed Nov. 18, 1925. For regulating the electrical conditions of a machine or circuit.

1,641,684. ADVERTISING DEVICE; W. H. McDonald, Overton, Nev., and F. E. Bessee, Los Angeles, Cal. App. filed July 12, 1926.

1,641,685. DRY-BATTERY CONSTRUCTION; E. E. Meisekothen, Madison, Wis. App. filed Aug. 28, 1925.

1,641,687. VACUUM CONDENSER; H. J. Nolte, Schenectady, N. Y. App. filed Oct. 8, 1925. In which the electrodes are located within a vacuum container.

1,641,691. PROTECTIVE SYSTEM FOR POWER-PLANT INSTALLATIONS; R. Pohl, Berlin, Germany. App. filed Sept. 22, 1924.

1,641,693. SYNCHRONOSCOPE; D. R. Price, Lynn, Mass., and F. H. Bowman, Swampscott, Mass. App. filed Oct. 25, 1926.

1,641,694. TRAFFIC-SIGNALING SYSTEM; J. J. Ruddick, West Newton, Mass. App. filed July 9, 1921.

1,641,702. MEANS FOR COOLING TRANSFORMERS; S. D. Sprong, Brooklyn, N. Y. App. filed May 4, 1925. For cooling oil-immersed transformers of the underground or manhole type.

1,641,704. ALTERNATING-CURRENT MOTOR; C. W. Steen, Norwood, Ohio. App. filed Oct. 16, 1922. Commutator type; wherein the motor is started as a repulsion motor and operated under normal running conditions with the rotor winding fully short-circuited through the commutator.

1,641,724. AUTOMATIC RECLOSING CIRCUIT-BREAKER SYSTEM; A. E. Anderson, Scotia, N. Y. App. filed Sept. 8, 1924.

1,641,725. SIGNALING SYSTEM; E. Austin, Schenectady, N. Y. App. filed July 9, 1924. High-frequency signaling system for use in connection with the transmission of high-frequency signaling currents over the conductors of a power-distribution system.

1,641,732. ELECTRIC REGULATING SYSTEM; W. Bruckel, Treptow, Berlin, Germany. App. filed May 24, 1924. Utilizing an electric discharge tube.

1,641,737. ELECTRICAL POWER TRANSMISSION; E. Clarke, Schenectady, N. Y. App. filed April 30, 1925. At high voltage over long distance.

1,641,757. COMBINED VOLTMETER AND PHASE-ROTATION INDICATOR; H. W. Hall, Lynn, Mass. App. filed May 26, 1924.

1,641,758. AUTOMATIC RECLOSING CIRCUIT-BREAKER SYSTEM; W. S. Hamilton, Schenectady, N. Y. App. filed Dec. 27, 1923.

1,641,761. CEMENT FOR INCANDESCENT-LAMP FILAMENTS; W. C. Ibele, Euclid Village, Ohio. App. filed Sept. 20, 1922.

1,641,762. SUMMATION METERING SYSTEM; B. W. Jones, Schenectady, N. Y. App. filed Feb. 17, 1927.

1,641,764. ELECTRIC FURNACE; W. J. Keenan, Schenectady, N. Y. App. filed Feb. 26, 1927. Heating resistor.

1,641,808. ELECTRIC CIGAR LIGHTER; Chicago, Ill. App. filed Nov. 26, 1926.

1,641,837. BATTERY; E. E. Bilgart and F. P. Bartlett, Chicago, Ill. App. filed March 7, 1923.

1,641,842. INSULATING MEANS FOR STORAGE-BATTERY PLATES AND SEPARATORS; E. W. Fletcher, Cuero, Tex. App. filed Oct. 11, 1926.

1,641,908. STARTING MEANS FOR INDUCTION MOTORS; B. Stechbart, Chicago, Ill. App. filed Nov. 30, 1925. In which an auxiliary or starter winding is provided in the stator or field of the motor and in which the circuit through this starter winding is controlled in response to variations in the magnetic field included in the armature.

1,641,940. SYNCHRONOUS CLOCK SYSTEM; F. W. Wood, Montclair, N. J. App. filed Aug. 22, 1923.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase or agency is desired in Dresden, Germany (No. 27,326), for electrical lunch-room equipment.

Purchase and agency are desired in Milan, Italy (No. 27,348), for three-phase and monophase motors, automatic disconnecting switches, switches with relays and electrodes for welding apparatus.

Purchase and agency are desired in Milan, Italy (No. 27,346), for refrigeration cabinets and equipment.

An agency is desired in Sydney, Australia (No. 27,324), for brass and copper wire on spools.

Purchase and agency are desired in Milan, Italy (No. 27,347), for enamel-covered wire and for insulating cloth, paper, cotton, silk and ribbons.

Purchase is desired in Calcutta, India (No. 27,410), of nickel-iron storage batteries.

Purchase and agency are desired in Gibraltar (No. 27,384), for electrical fittings.

Purchase and agency are desired in Mannheim, Germany (No. 27,378), for electrotechnical novelties and appliances.

Purchase is desired in Mexico City, Mexico (No. 27,375), of household electrical appliances, especially vacuum cleaners.

New Trade Literature

HOTEL-LIGHTING SPECIALTIES.—The F. W. Wakefield Brass Company, Vermilion, Ohio, has issued a data sheet on its "Red Spot" hotel-lighting specialties.

INDUCTION MOTORS. — The Reliance Electric & Engineering Company, Ivanhoe Road, Cleveland, has issued bulletin No. 101, which describes and illustrates its type "AA" "Reliance" induction motors with ball bearings for two-phase and three-phase alternating-current circuits. The bulletin covers in detail the design of the type "AA" motors.

ELECTRIC WATER HEATER. — The Automatic Electric Heater Company, 1505 Race Street, Philadelphia, is distributing a pamphlet covering the "Sepco" sun-electric water heater, cabinet type, illustrating possible applications with "Sepco" combination ranges and electric water heaters.

AIR COMPRESSOR GOVERNORS. — Bulletin GEA-795 issued by the General Electric Company, Schenectady, N. Y., covers its type "ML" and type "MJ" governors.

ALTERNATING-CURRENT AUTOMATIC STARTERS.—The Industrial Controller Company, Milwaukee, has issued bulletin No. 8532D, describing and illustrating the "I-C" across-the-line type alternating-current automatic starters with thermal overload relays.

SAFETY HAND LAMPS.—The Crouse-Hinds Company, Syracuse, N. Y., is distributing bulletin No. 2,103, describing and illustrating its safety hand lamps with grounding terminal.

OIL SWITCHES AND CIRCUIT BREAKERS.—The Condit Electrical Manufacturing Corporation, Boston, has issued bulletins Nos. 471 and 472, containing descriptions and illustrations of its oil switches and circuit breakers for 7,500-volt 800-amp. and 2,500-volt 400-amp. service respectively.

INSTRUMENT CURRENT TRANSFORMERS.—The Pacific Electric Manufacturing Company, 5815 Third Street, San Francisco, has issued bulletin No. 14, which describes and illustrates the Pacific type "OA" instrument current transformers.

TELEPHONE SYSTEMS AND DEVICES.—Edwards & Company, Inc., 140th and Exterior Sts., New York City, has issued catalog No. 12, which describes and illustrates its various telephone systems and devices.

VALVES.—The Belknap Manufacturing Company, Bridgeport, Conn., is distributing bulletin No. 1-O, describing and illustrating the Belknap type "M" valves designed for the control of electrical insulating oils as in a transformer. Dimension data are also included.

ACROSS-THE-LINE MOTORS. — The Wagner Electric Corporation, 6400 Plymouth Avenue, St. Louis, has issued bulletin No. 152, describing and illustrating the new Wagner across-the-line standard squirrel-cage motors up to and including 20 hp.

STATION OIL CIRCUIT BREAKERS.—Bulletin GEA-599 issued by the General Electric Company, Schenectady, N. Y., describes and illustrates its station oil circuit breakers for 7,500-volt to 220,000-volt service.

INDUSTRIAL HEATING APPARATUS. —Catalog No. 25 issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., covers its various industrial heating apparatus.

POTENTIAL TRANSFORMER PROTECTIVE DEVICE. — Bulletin AD-1003 issued by Schweitzer & Conrad, Inc., 4435 Ravenswood Avenue, Chicago, treats of their type "DLC" fuse, combination mountings and wire-wound resistor for application in conjunction with the S. & C. type "DLC" fuse. Complete dimension data are included.

ELECTRIC FURNACES.—The W. S. Rockwell Company, 50 Church Street, New York City, has issued leaflet No. 281, describing and illustrating the various types of electric furnaces. It also recounts the advantages of electric industrial heating equipment.

ILLUMINATING ENGINEERING DATA. —The Holophane Company, Inc., 342 Madison Avenue, New York City, has issued a new commercial edition of the Holophane Catalog No. 375-E. This publication contains engineering information on modern lighting practice and lists many new lighting devices which have been developed for specific application in varied locations.

GROUNDING SYSTEM. — Bulletin G-6 issued by the Crouse-Hinds Company, Syracuse, N. Y., contains illustrated suggestions for a service entrance and ground system and also suggestions for grounding an industrial installation.

SAFETY SWITCHES, PANELBOARDS, ETC.—A complete catalog comprising various bulletins has been issued by the Bull Dog Electric Products Company, Detroit, which covers the Bull Dog safety switches, Bull Dog "fusenters," panelboards and cabinets.

AIR-JACKETED MOTORS.—The Wagner Electric Company, 6400 Plymouth Avenue, St. Louis, has issued bulletin No. 151, covering its single-phase 1-hp. to 20-hp. repulsion-induction motors, type "CA," and its polyphase squirrel-cage motors, 2-hp. to 30-hp., type "CP." The bulletin gives illustrations and descriptions of the motors.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for
the Use of All Interested in Analyzing the
Trend of the Electrical Business

Domestic Electrical Energy Rates Still Decreasing

IF THE people of the United States should suddenly, in bargain-counter fashion, concentrate their purchases on that domestically used commodity or service which is the most favorably priced compared with 1913, the demand would fall heavily on our electric light and power stations. While living costs are uniformly much higher than before the war, the price of electricity for domestic uses has decreased continuously for many years, with minor exceptions, and now stands 12.3 per cent lower than in December, 1913. The weighted average of all items in the cost of living is 73.4 per cent higher than in December, 1913.

These data are based on a semi-annual survey of living costs in 32 cities throughout the United States and are carried to June, 1927. They appear in the August issue of the *Monthly Labor Review*, published by the Bureau of Labor Statistics of the United States Department of Labor.

The chart shows the changes that have taken place and the cost of each group of items, December figures being plotted for every year except 1927.

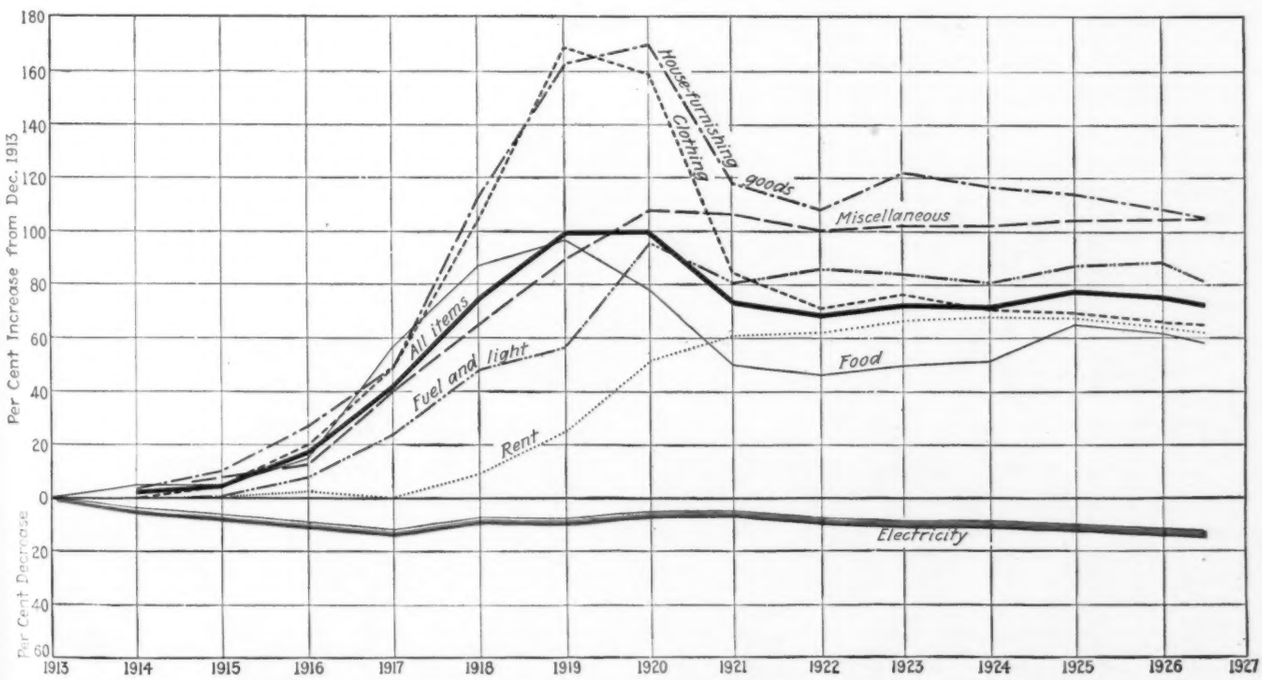
The peak of prices came in 1920; in December of that year the average living cost was fully double that of seven years earlier. It had been even higher in June.

By the end of 1921 the excess over the 1913 price had decreased to 74 per cent; it has hovered close to that figure ever since. Food costs are higher by 58 per cent, clothing by 65 per cent, rent 62 per cent, fuel and light 81 per cent, house-furnishing goods 105 per cent, and miscellaneous domestic supplies by 105 per cent. The relative price of manufactured gas for domestic consumption has shown a net rise of 28.4 per cent. The 1913 household dollar has shrunk to $0.58 and seems destined to stay there. The electrical dollar alone has grown in buying power. And this despite higher wages as well as higher cost of fuel and supplies. The wholesale price of bituminous coal averaged 76 per cent higher in June, 1927, than in 1913. Wages have risen fully 100 per cent.

With most of our daily needs, if the demand were increased the price would probably rise. Not so with electricity. With increased use the average rate would fall, for the increase would come on the lower steps of the rate schedule.

A very moderate increase over the present estimate average daily consumption of somewhere around 8 cents worth of electrical energy per day would add much to the revenue of the industry, and for the user would add considerable service at a low rate.

Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote for use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics would give credit to the ELECTRICAL WORLD.



Increase in Cost of Living and Decrease in Cost of Electricity Based on December, 1913, Prices

Production in North Central States Under Last Year

THAT the manufacturing plants of the North Central States have been curtailing their operations since May at about the same or at a slightly greater rate than during the same period last year is indicated by reports of monthly energy consumption of electrical energy furnished the ELECTRICAL WORLD by some 850 manufacturing plants operating in the section and in various industries. Taken as a whole, the first eight months of the year witnessed production in about the same volume as for the same period last year. During the first quarter of the current year the production volume of these plants was about 6 per cent under that of the same months of last year. Subsequent to March, however, the volume of monthly production has been on a par with or above that reported for the same month of last year.

The actual volume of production during August was about 5 per cent over that of July, but when correction is made for the fact that August had two more working days than the month previous, it is found that the rate of general production during August was about 2.5 per cent under that reported for July. The productive activity during August was also about 4 per cent under that of August, 1926, although the actual volume of commodities produced was virtually the same as that reported for last year.

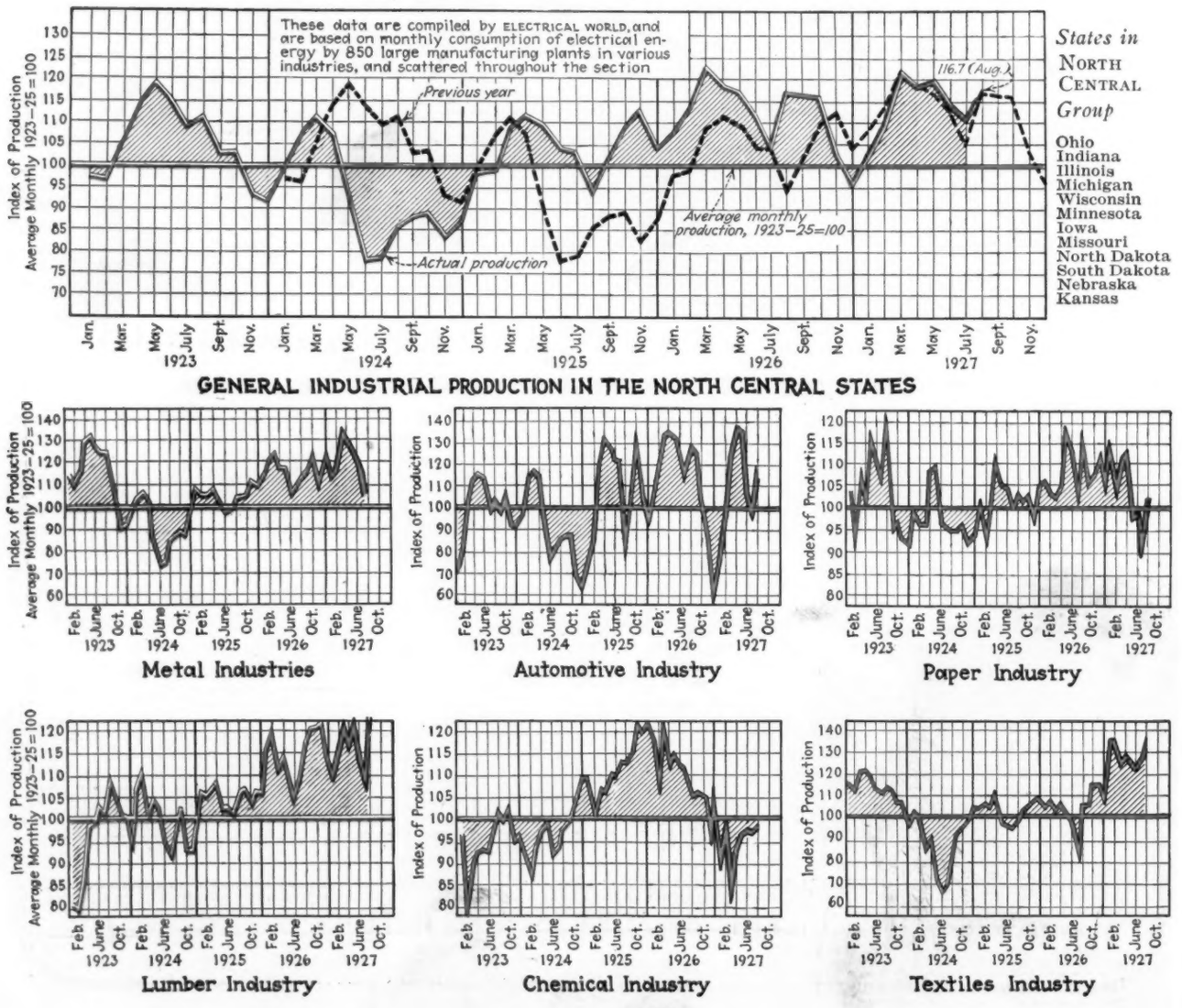
The production figures for the past few months indicate that operations of the manufacturing plants of the North Central States during the summer months were considerably above those of last year, but that the fall season opened with the rate of production some 4 per cent under that of last year. There is every reason to expect that the industries of the section will witness increased activities as the fall advances. The iron and steel industry is operating at a comparatively low level compared with last year, and the activity in the automobile manufacturing plants during August was about 14 per cent under that of August last year. Both of these basic industries should increase their operations more than seasonably during the coming months.

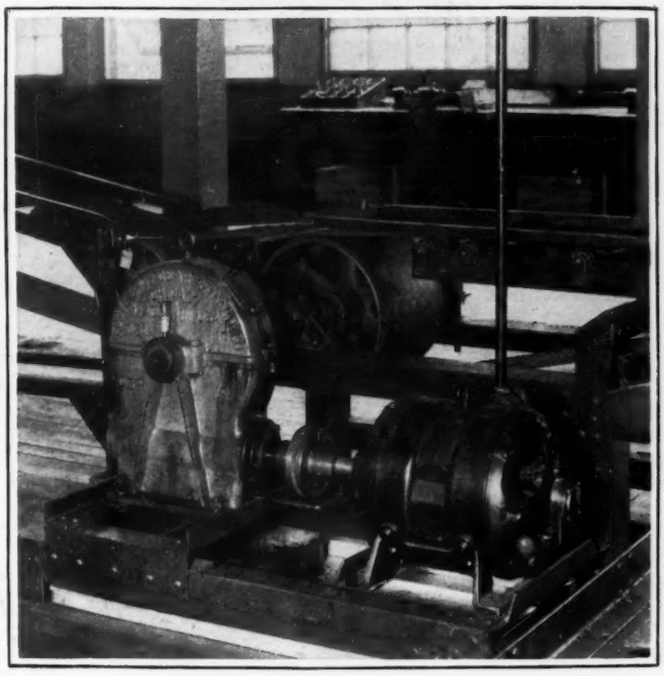
The metal industries group, which includes both ferrous and non-ferrous working plants, were operating during August at a rate about 13 per cent under August last year. The volume of production of this group during the first eight months of the current year, however, was about 3 per cent over that reported for the same period last year.

The operations of the automobile and automobile-parts manufacturing plants since the opening of the year have been under those reported during 1926, with the exception of April and May. An upward trend was witnessed during August, but of much smaller proportions than was reported in August last year. The current year should witness a total production about 10 per cent under 1926.

ELECTRICAL WORLD *Barometer of Industrial Activity in the North Central States*

(Data Unadjusted for Seasonal Variation)





Ball Bearing Motors are Trouble-Free

WHERE motors are in the production line as are the conveyor motors, shown above, liability to bearing trouble should be reduced to the minimum. This motor must not stop, for to do so would hold up production on the entire line. The manufacturer here has safeguarded continuity of production by using electric motors equipped with New Departure Ball Bearings.

New Departure-equipped motors cost less to operate, for bearing wear is practically eliminated because of minimum friction. Maintenance expense is cut to the core, for New Departures never need readjustment and require lubrication only once a year. In other words, they run practically without attention.

Write for literature published by our Engineering Department regarding "Advantages of Ball Bearings in Electric Motors." Sent on request.

THE NEW DEPARTURE MANUFACTURING COMPANY
Chicago *Bristol, Connecticut* Detroit

New Departure Quality Ball Bearings

683

As They Say At The Beckwith Company

Class 8527. Automatic A. C. Across-the-Line Starter with push-button control.

Write for Catalog

Mr. F. C. Huller, *Chief Electrician, The Beckwith Company, Dowagiac, Mich. says:*

"Our first Industrial Controller Automatic Starter was installed in 1923; now we have about 60 I-C starters and automatic compensators, classes 8527, 8526, 8605. These are used on individually driven machines in foundry, machine shop, assembly rooms, sheet-metal plant, pattern shop, etc., in the manufacture of our well-known line of Round Oak Stoves and Furnaces.

"Our object in installing automatic starting equipment was to conserve power, lower motor and machine repairs, end fuse replacements, and keep production going. As a direct result of using automatic starters and compensators, we rewound only half as many motors in 1926 as we did in 1923.

"In spite of frequent starting and stopping, our I-C Across-the-line Starters have stood up remarkably well and none of them has ever required repairs. In fact, the only maintenance given them is a weekly inspection. Automatic starters of another make have required considerable repairs and replacement of parts.

Industrial Controller Co.
MILWAUKEE, WIS. U.S.A.